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PART II.

On Treatment of Diseases of the Heart.



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By Prof. Dujardin-Beaumetz.

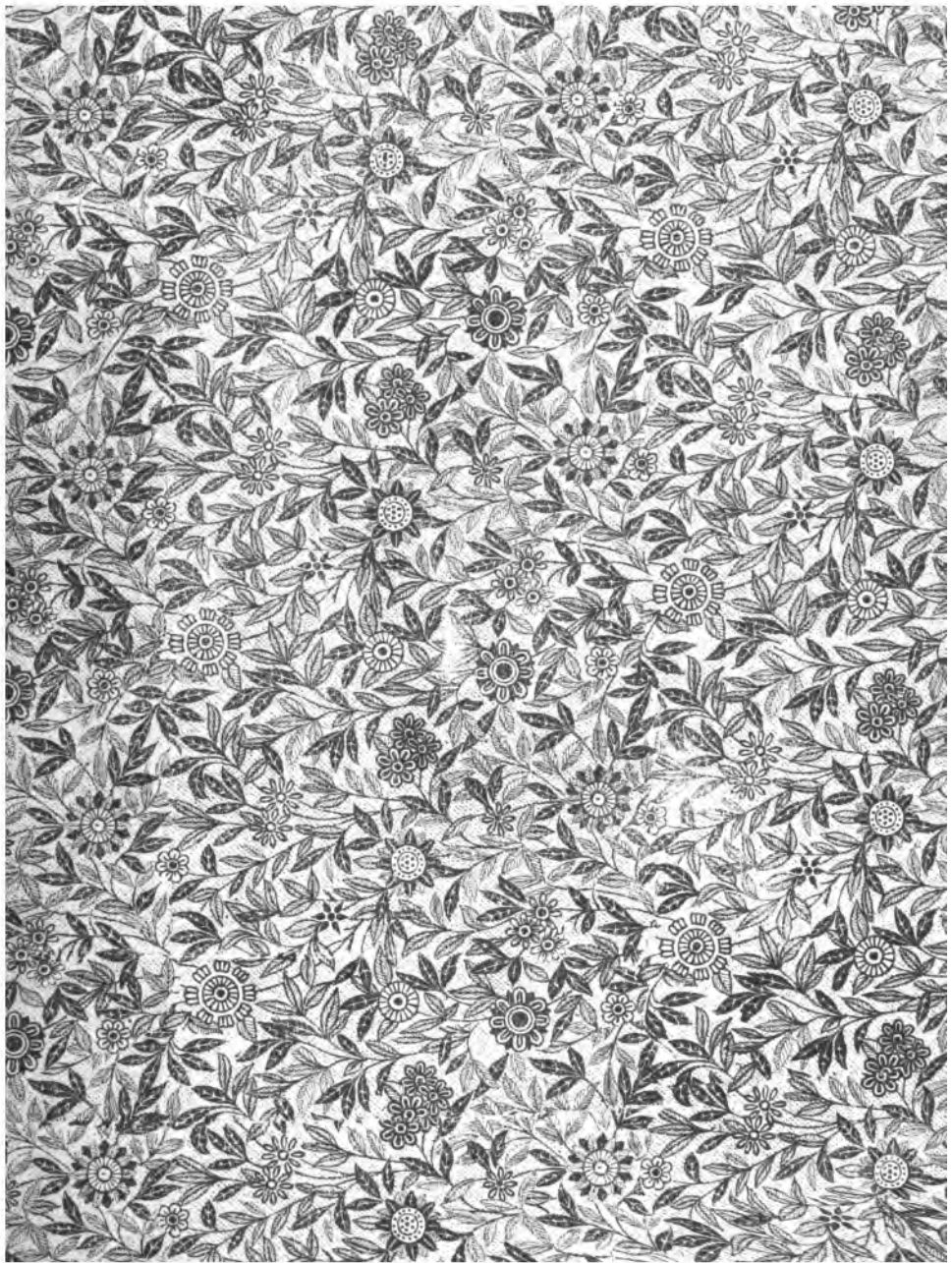
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THE
MODERN TREATMENT OF DISEASES OF THE HEART.

PART II.

DISEASES OF THE AORTA.

BY

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TRANSLATED FROM THE FOURTH FRENCH EDITION

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1887.

GEORGE S. DAVIS,
DETROIT, MICH.

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PREFACE.

In presenting to the medical profession of the United States this treatise on the therapeutics of Aneurisms of the Aorta—a theme on which comparatively few works have been written—the translator trusts that this little volume will be welcomed by physicians and surgeons as a comprehensive, interesting, and practical exposition of the subject. Some new matter has been added to bring the work fully abreast of the times.

DISEASES OF THE AORTA.

CHAPTER I.

TREATMENT OF ANEURISMS OF THE AORTA

SUMMARY.—The Diseases of the Aorta—Treatment of Aneurisms—Necessity of Exact Diagnosis—Causes of Error—Therapeutic Means Proposed—Method of Valsalva and Albertoni—Inopexia—Compression—Protective Trusses and other Apparatus—Rupture of the Aneurism—Danger of Compression of Thoracic Aneurism—Its Good Effects in Aneurism of the Abdominal Aorta—English Method and Method of Broca—Subcutaneous Injections of Ergotine—Applications of Ice—Their Advantages and Disadvantages—Internal Medicaments—Salts of Lead—Alum—Digitalis—Iodide of Potassium.

GENTLEMEN.—The chronic affections of the aorta are little influenced by therapeutic means, and when you have to do with acute or chronic aortitis, the treatment instituted is directed more against the symptoms and incidents of the malady than against the malady itself; as, moreover, the symptoms, which are largely due to the influence of the lesion on neighboring organs, are similar to those caused by alterations of the orifice and especially aortic insufficiency, it is plain that the treatment will be nearly alike in both cases.

Therefore I shall concern myself here with the treatment of only one of the diseases of the aorta,

rare, it is true, but deserving your serious attention, for you will see that the physician may, by appropriate means, sometimes arrest the march of the affection; I allude to aneurism of the aorta. What emboldens me to take up the subject, is that we have just at the present time in our wards a man suffering from aortic aneurism on whom I propose to apply a mode of treatment thus far almost unknown in France. Another patient, also in our wards, and who was sent here by my confrère Dr. Malfilâtre, has an enormous aneurism of the aorta which will give you a good idea of the extraordinary development which these aneurismal pouches sometimes present.*

As I have done in the case of affections of the

* This patient, aged fifty years, had in the posterior and lateral region of the left chest an enormous pulsating tumor measuring twelve centimetres in height. This tumor gave no bruit de souffle to auscultation but only a double bruit de battement [an accentuated booming sound, described by some writers as a systolic jog or shock.]

The heart appeared to be healthy. There was considerable oedema of the lower extremities.

Dujardin-Beaumetz, considering the state of the patient, who was cachectic, considering also the enormous size of the tumor, felt it inexpedient to try electrolysis, and the patient in the course of three months succumbed to the progress of the cachexia.

The autopsy confirmed the diagnosis which had previously been made. There existed in the thoracic cavity, on the level of the insertion of the diaphragm, an enormous aneurismal pouch completely surrounding the vertebral column, and pre-

senting a circumference of 57 centimetres. This pouch consisted of two portions; one, much the larger, occupied all the left side of the thorax, crowding the lung into the upper part of the chest, and reducing it to the size of a tongue-shaped lamella. The other part passed over to the right of the vertebral column, projecting somewhat into the corresponding side of the thorax. This tumor crowded hard on the ribs of the left thorax, and had actually destroyed the eighth, ninth and tenth ribs. The heart, forced somewhat toward the middle line, rested on the tumor; it was of normal size and texture. The aorta was healthy as far as the descending and posterior portion, where was found an opening of communication, seven centimetres in extent, into the aneurismal pouch. This pouch contained a voluminous clot which was composed of two parts: the middle part, corresponding to the aorta and vertebral column, was of new formation, while the lateral portions, constituting the right and left parts of the tumor, consisted of fibrin of firmer consistency and much older deposition. The vertebral column, which lay bare in the tumor to the extent of eighteen centimetres, presented a profound and very curious alteration of the first six dorsal vertebræ. The intervertebral spaces alone remained intact, while the bodies of the vertebræ were deeply excavated and altered.

Dujardin-Beaumetz, in reporting this case to the Society of the Hospitals, December 28th, 1877, exhibited the pathological specimen, dried and skilfully prepared by his colleague, Anger; the pathological peculiarities above mentioned were well shown. He also called attention to the following important facts in the case: The diagnosis had been very accurately made months before the death of the patient by Constantin Paul; there was no paraplegia, despite the profound alteration of the vertebral column; the presence of the enormous fibrinous coagula which had spontaneously formed in the tumor, was a feature of considerable practical interest.

aortic orifice (*vide* Part I), I shall touch briefly on the classification and symptoms of aneurisms, remarking at the same time that I intend to speak only of the false consecutive aneurism, constituted by a pouch of thickened connective tissue communicating with an artery. Here the diagnosis should be very precise; too much importance, in fact, cannot be placed on an accurate diagnosis, without which the treatment must be vacillating and uncertain. This remark is especially applicable to the medical history of aneurisms of the aorta; and it is because practitioners have so often been mistaken in their diagnosis, that we hear of cures attributed to certain medicines that are of doubtful utility, if they have any utility at all in these affections.

The following particulars about these aneurisms are designed to freshen the memory of the reader :

Aneurisms of the aorta, more frequent in men than in women (the proportion, according to Lebert, is as 10 to 3), more frequent also in England than in France, are seated generally on the ascending aorta, in the neighborhood of the sinus Valsalva; next in the order of frequency they are observed on the arch of the aorta, the thoracic aorta, and the abdominal aorta. They have been divided into:

1. True aneurism : dilatation of the three coats of the artery.
2. Mixed external aneurism: the middle and internal tunics are destroyed, and only the external remains.
3. Mixed internal aneurism: either the middle coat has given way, and the inner and outer are preserved, or the two outer membranes are ruptured, and the inner projects through the crevice thus left, in the form of a hernia.

4. False consecutive aneurism: all the coats have given way, and the sac is formed of the surrounding cellular tissue in a state of condensation.

5. Varicose, or arterio-venous aneurism: here there is communication between the aneurismal pouch and some neighboring vein, as the vena cava or pulmonary artery. The most frequent is aneurism of the aorta communicating with the pulmonary artery; the least common is aneurism of the arch opening into the superior vena cava.

5. Dissecting aneurism: this form is observed in people advanced in life, and is very rare; the blood collects between the external and the middle and internal tunics. There may be but one foramen of communication, or the blood which finds its way into the sac thus constituted by the external coat, may find its way back into the aorta by another opening.

7. Diffuse aneurism: the blood is extravasated into the areolar texture of a part by rupture of the arterial pouch. We have an illustration of this in the case of aneurism of the abdominal aorta bursting into the sub-peritoneal cellular tissue. The most frequent varieties are the true aneurism, and the mixed external aneurism. The forms are variable: fusiform, or cylindroid, sacciform, and the flask-shaped aneurismal pouch (*en poche à collet*). The cylindroid is ordinarily the true aneurism with its three tunics; the sacciform is the kind which acquires the greatest volume, and is generally of the mixed internal variety, with adhesions of the internal and external coats through the torn middle coat. The flask-shaped aneurismal pouch is a variety of the preceding, and is constituted, according to Kokitansky, by a hernia of the internal through the middle tunic.

Of relatively recent discovery¹, denied by some of the older authorities, and affirmed by others, aneurism of the aorta was not truly known till the begin-

ning of this century, and if we are able at the present day, in most cases, to make a certain diagnosis, we owe this to the wonderful progress which has been effected in our means of investigation. It is owing to percussion, to auscultation, and to the graphic method which enables us to study simultaneously the beatings produced in the arterial tumor and the beatings of the heart, and to compare the tracings obtained, that we can limit the extent of the pouch, determine its dimensions, and ascertain the size of the opening by which it communicates with the aorta.

Despite all these means, you have doubtless seen blunders in diagnosis perpetrated by physicians the most distinguished and the most expert in physical examinations. You can then readily understand that if our authorities sometimes make mistakes at the present day, how great must have been the chances of error years ago when physicians did not possess all the means of investigation which we have now. You will, do well, then, in estimating the results of any line of treatment, to take account of the epoch when the observations were made, in order to give to the facts recorded their just value.

Although in these lectures I cannot go at length into the diagnosis of aneurisms, I desire to point out a source of error which is of frequent occurrence, and one by which you may be liable at any time to go astray. I refer to the presence of a more or less extensive pulmonary cavity in proximity to the arch of the aorta. In cer-

tain phthisical patients, in fact, you will observe, owing to the proximity of the large vessels and of the heart, not only loud booming sounds (*bruits de battements*) and energetic pulsations which simulate aneurisms, but also veritable expansive movements, which are regarded as the pathognomonic sign of aneurismal pouches.

Among my professional experiences I recall to mind a case which I witnessed at the Charity Hospital, of a patient who presented these beatings and these expansive movements at their maximum of intensity. All those who had examined this man affirmed the existence of an aneurism of the aorta, but the autopsy corrected this mistake, and showed us, not an aneurismal pouch, but a simple cavity in the upper part of the lung, in relation with the arch of the aorta.

It seems to me that we have not as yet had a sufficient explanation of these expansive pulsations, and I am led to believe that they are brought about in the following way: the pulmonary sac in contact with the aorta, especially if the cavity is large and communicates with the bronchi by a very small opening, represents to the observer the apparatus of which Marey makes use in registering the pulsations of the heart.

The cardiograph, in fact, is as you know, constituted by a tense membranous sac, the least movements of which, transmitted by the air which it contains, influence a drum which puts in motion the in-

dex which is arranged to register the pulsations. Now in the case above mentioned, each pulsation of the aorta produces in the air of the pulmonary cavity a commotion similar to that of the cardiograph, leading to movements of expansion corresponding to the beatings of the aorta.

What are the therapeutic means which have been proposed for the cure of these aneurisms?

Until of late years almost the only treatment pursued was that of Albertini and Valsalva. This consisted in subjecting the patient to low diet and prolonged repose. To render the emaciation greater, the patient was frequently bled, and he was so reduced before it was thought proper to "build him up" again, that he would hardly be able to raise his arm from his bed. Pelletan, Hopes, Hodgson, Chomel practised this method with some modifications which had to do with the quantity of blood to be abstracted at any one time. Ought the vein to be opened with a free incision, and blood to be abstracted till fainting supervened? Or ought a less heroic plan to be adopted? These were the points under dispute; there was no difference of opinion as to the utility of blood-letting in the treatment of aneurisms of the aorta, and you will not be surprised to learn that Hopes was in the habit of taking each day, and for sixteen consecutive days, 300 grammes (or half an imperial pint) from his patients.

Dr. Waters of Liverpool reports a successful result obtained by Valsalva's method.

A man forty years of age had a pulsating tumor under the right clavicle; he was treated without success by doses of iodide of potassium and sugar of lead internally, and by applications of ice externally. Then he was subjected to absolute rest in bed day and night for six weeks; he was not allowed to raise his head from his pillow. For nourishment he was limited to seven ounces of bread a day with three of meat and eight of liquid; he was also permitted to swallow little bits of ice, and smoke a pipe. This severe regimen resulted in a cure.*

At an epoch, however, nearer our own times, Dr. Bellingham of Dublin took up again the method of Albertini and Valsalva, and applied it, with some modification, to the treatment of aneurisms. He omitted the blood lettings, but put the patient on starvation diet, allowing him only two ounces of liquid and two ounces of solid food per day; the patient moreover was required to keep on his back, in bed, during the entire duration of treatment. At the end of a certain time, when the signs of aneurism became less marked, a restorative treatment was by degrees instituted.

How are we to explain the cures obtained in these cases, and recorded in so many published observations? Must we believe that all the observers were mistaken, and that in every instance a wrong diagnosis was made? I should not be disposed to affirm all this; and while admitting that in many cases an error

*Brit. Med. Times, 1856.

in diagnosis was probable, I would not say that it was so in every case, and am obliged to seek for another explanation.

You know, gentlemen, that under certain influences there occurs a coagulation of the fibrine of the blood in the interior of the vessels, and clots of greater or less size result, especially in the venous system. This particular condition has received the name of *inopexia* (increased coagulability of the fibrinogenous substance); a state of cachexia is very likely to induce this alteration of the fibrine, and it is possible that in the case of the patients treated by the method of Albertini and Valsalva, there may have resulted from this depleting regimen an artificial cachexia, which led to blood-clotting in the aneurismal pouch. If we add to this fact still another, demonstrated by physiological experiments, that there always exists between the number of globules and the fibrine of the blood an antagonism, such that the more the number of the globules diminishes, the more the proportion of fibrine augments, you will readily understand that this double influence, both of the globular deficiency produced by the bleedings, and the cachectic state brought about by the rigorousness of the regimen, may lead to the production in the aneurismal pouch of clots more or less voluminous.

But what is less easily understood, is how these coagula can become active clots. You doubtless remember the valuable researches of Broca, which have

shed so much light on the treatment of aneurisms by showing the influence both of active and passive clots; the one conducive of permanent cure, the other effecting only a temporary amelioration.²

The barbarous and cruel method of Valsalva has long since been abandoned, and at the present day no one would dare propose such a depleting and starvation mode of treatment. On the contrary, in accordance with the desire to augment the fibrine in the blood, we support and feed the patient by giving him azotized substances abounding in the materials of fibrine, in order to obtain, when coagulation takes place, active fibrinous clots which shall cause a permanent obliteration of the sac.

You know, gentlemen, that compression has given good results in the treatment of surgical aneurism, and Vanzetti, by his ready method of digital compression, has rendered this treatment still more efficacious; it has been proposed to apply the same procedure to aneurism of the aorta. But here the difficulty is great. Situated deeply in the thoracic cavity, the aorta passes down into the abdomen in close proximity to the vertebral column, and becomes separated from the abdominal walls by the entire thickness of the intestinal mass; compression of aneurisms of the thoracic aorta is impossible at their origin, and can only be made when the tumor, having destroyed the intercostal spaces or the ribs, makes protrusion externally.

In cases of this kind, it has been advised to apply

an apparatus resembling a tourniquet, and coatings of flexile collodion have even been recommended, as likely by their retraction to exercise a gentle and prolonged compression on the walls of the pouch.

Broca has recently exhibited two patients who owed to the employment of this method a notable amelioration; both had extra-thoracic aneurismal tumors over which had been painted several successive coats of collodion.³

Despite these fortunate results, I am compelled to dissent from this mode of treatment. You should remember, gentlemen, that the most formidable aneurisms, those which form the largest pouches, only exceptionally open externally; ordinarily the rupture takes place from within, producing a hemorrhage which is rapidly fatal. I remember well of seeing in the service of Behier a patient afflicted with an enormous aneurismal tumor; the thin bluish skin led us to fear any moment rupture of the external portion; the result was different from what we expected, and the patient succumbed from hemorrhage into the lungs. Cases are even on record of patients who presented a punctiform lesion of continuity (scarcely apparent) of the cutaneous covering of a voluminous thoracic tumor, and who were enabled to live a long time by reason of a protective truss which prevented the perforation from becoming larger, and who finally succumbed to internal hemorrhage.

The danger, you see then, is not on the side of

the skin, but of the viscera. When you make external compression, however moderate, you promote the development of the pouch on the side of the viscera, and that favors its rupture internally; and this is not all: compression may detach the clots already formed, and cause them to enter the general circulation. What I have here said, gentlemen, is something more than mere theory. Tillaux has given the details of a case where a very moderate amount of compression over an aneurismal tumor produced very serious embolic accidents.⁸ Avoid compression, then, at any rate when you have to do with aneurisms of the thoracic aorta.

The same advice, however, does not apply to aneurisms of the abdominal aorta, and here, from a therapeutic point of view, the difference between these aneurisms and thoracic aneurisms is very great. Compression, in fact, has produced excellent results in abdominal aneurisms, and in a recent thesis Woirhaye has given some statistics which show that out of nine cases thus treated there were six cures; a proportion relatively large.⁹

This method, which has not been practised in France, is quite popular with our neighbors across the Channel; it is, in fact, in England that all the operations of this kind have occurred.

Employed at first by Williams of Newcastle, and next put in usage by Murray, Bryant, Wheelhouse, Greenhow, Moxon, Durham, Paget and others, treatment by compression is performed under chloroform

with a special apparatus which compresses the aorta above the tumor. In order to be complete, very energetic pressure is required; so you will not be surprised to learn that in certain unsuccessful cases, patients have succumbed to peritonitis consecutive to the brutality of the operation, or the rupture of intestinal coils. Woirhaye, in order to obviate these accidents, counsels in this operation the method of Broca, which consists in séances of incomplete compression at first, to be made more and more complete afterwards; he does not favor the English mode of total and complete compression. This is a very important point in treatment, and if you are in presence of a sacciform aneurism of the abdominal aorta which by its position enables you to make compression above the pouch, do not hesitate to have recourse to this method with the modifications counselled by Woirhaye.

By a quite different line of treatment, it has been proposed to obtain essentially the same result. It was an ingenious notion of a German surgeon, that by augmenting the contractility of the pouch, its size might be materially reduced. Langenbeck was the first to attempt to carry out this principle, by means of subcutaneous injections of ergotin. Knowing the special property of ergot to cause muscular contractions of the walls of the blood vessels, Langenbeck thought that by practising these injections in the vicinity of the pouch, he could obtain a gradual shrinkage of the aneurism.⁹

Despite the successful results obtained by the German surgeon, I cannot recommend this procedure. Although a believer in the efficacy of injections of the alcoholic extract of ergot, which I often practise, as you know, in my hospital service, I would not dare to employ them in the treatment of aneurisms, especially if called upon to make these injections in the vicinity of the aneurismal pouch. As a result of such injections, in fact, one will often observe indurations and inflammations of the cellular tissue, even abscess, and I should fear the production of such untoward accidents in the neighborhood of an aneurism.*

By the side of these means, which act on the pouch whether by indirect compression, or by inducing contraction of the sac, we should place the usage of ice, which has been very much vaunted, and has given in certain hands, and particularly in those of Goupil, favorable, and even curative results. Bladders filled with ice or some refrigerant mixture are applied over the aneurismal pouch if it protrudes externally, or over the part of the thorax corresponding to the pulsating tumor, and are kept in contact with the tumor for weeks and even for months.

*Burggrave reports a successful case of aneurism of the innominata which he treated by painting over the tumor ferrosodic hæmostatic (equal parts sat. sol. common salt, and the liquor ferri perchlorid); at the same time administering internally ten drops t. i. d.

How does ice act? Some say that the cold produces coagulation in the sac. This is a mistake which has been well shown by physiological experiments, and especially by those of Claude Bernard. Cold, instead of favoring coagulation, retards it, and when in bleeding an animal, you collect the blood in two vessels, and expose the one to a temperature below zero, and the other to a temperature higher than the blood, you will always see coagulation take place very slowly in the first vessel and with great rapidity in the second.* If now we were seeking by modifications of the temperature to promote coagulation of blood in aneurisms, it is not the application of cold, but of heat, to which we should resort. If then ice gives good

[Prof. Eulenberg's formula for injection of ergotine is as follows:

R Ergotin, gr. ij.
Alcohol. glycerine ää 3 ss.

Five minims, to be thrown into the neighborhood of the tumor every day, or every other day.]

* John Davy has remarked that at zero coagulation was retarded by one hour, and that it was accelerated by elevation of the temperature; it is more rapid at 30° R. than at 20° or 25°; there are, however, irregularities, and coagulation is less rapid at 38° R. than at 25°.

According to Scudamore, cold retards spontaneous coagulation almost in the same proportion that heat accelerates it. (John Davy. Edin. Med. and Surg. Jour., Vol. XXX, Scudamore, Essay on the Blood, 1834.)

results it must be in another way; perhaps by causing contraction of the sac, or more likely, by the inflammation resulting from the constant cold application. This is the *modus operandi*, in my judgement, of ice as a remedy in aneurisms.

Therefore, without altogether taking ground against the use of this means, I would be chary in its employment, in consideration of the uncertainty of the results obtained. There are, moreover, serious disadvantages connected with these cold applications; the vitality of the skin is lessened, which is a real evil if the pouch tends to protrude externally, and is only separated from the exterior by a thin and purplish skin. Cold, moreover, often determines congestions of the lungs, and provokes bronchites which may be of grave nature, and these are unfavorable complications which should be avoided at any price.

It has also been recommended, in order to obtain reduction in the size of the sac, to galvanize the external surface of the aneurismal tumor; and Vizioli and Martino have reported two successful cases of aneurism treated by this method; the one of the innominate, the other of the right subclavian.⁷

Lastly, in order to obtain the cure of aneurisms of the aorta, medical authorities have recommended internal medicaments, some of them being intended to favor coagulation by their presence, others having for their object to modify the state of the cardiac circulation, while others still are credited with possessing a

general action on the circulation, which, however, is not well understood.

The first group of these medicaments is represented by the salts of lead, and the acetate of lead in particular.*

This salt, employed by Dupuytren, Laennec, Bertin, and other authorities, has, according to the reports, given quite favorable results. Sugar of lead has been prescribed in the dose of one or two grains, gradually increased to fifteen.

Alum, which has been advised by Sabatier, and comfrey, which Pelletier^o used to give with syrup of quinces, and elixir of vitriol (acid sulphuric arom.) have been supposed to fulfil the same indication. To-day these medicaments are abandoned, and I do not believe that they have ever given any well demonstrated curative results.

Digitalis has also been vaunted; it was believed that by this agent it might be possible to effect diminution in the pulsation of the pouch, and to favor the coagulation of the blood. This seems to me more than problematical, and for my part I cannot but think that digitalis, like every other medicine which increases arterial tension, can only give bad results in the treatment of aneurisms, and recently Mahomed has insisted, with much reason, on this point.*

*The first condition in the treatment of aneurism of the aorta, says Mahomed, is to diminish as much as possible the arterial tension, and this result is attained by a carefully regu-

Thus far, as you have seen, the medicaments mentioned may be said to be of questionable efficacy in aneurisms of the aorta; this is not the case with iodide of potassium, which must be credited with numerous cures. Dr. Chuckerbutty, hospital physician to the College of Calcutta, was the first, in 1862, to introduce this remedy into the treatment of aneurisms, and if his first reported observations were not very convincing, it is not so with the facts which have been observed subsequently.

G. W. Balfour, in 1868 and in 1872, published twelve cases of aneurism where iodide of potassium gave satisfactory results. He has always observed, under the influence of the treatment, a diminution, not only of the volume of the tumor, but also of the

lated dietetic regimen, which must be but slightly azotized, by repeated purgations, by sweatings brought about by warm baths or other means, by diuretics, and especially by rest. You may employ jaborandi, nitrite of amyl, and chloroform, but the action of these medicaments is temporary; they in fact act by relaxing the muscular coat of the arteries and lessening their fulness, and thus giving more space to the blood which they contain. They are indicated when a momentary relief for the pain is sought for.

Aconitia and veratria may be employed to diminish the force of the beatings of the heart, but digitalis and ergot, which augment arterial tension, should be proscribed. It is well to give iodide of potassium to favor contraction of the sac and coagulation of its contents. In the event of failure of all these means, Mahomed recommends to have recourse to galvanopuncture.—*Brit. Med. Jour.*, June 8, 1878.

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pulsations; the sac became harder, and sometimes he obtained almost complete disappearance of the aneurism.¹⁰

Still later, Potain has also obtained from iodide of potash the well nigh total disappearance of a very voluminous aneurismal tumor of the arch of the aorta. Constantin Paul has noted two similar cases; and Bucquoi has reported a case where the iodide much improved the condition of the patient. More recently, Byrom Bramwell has published in the London Lancet for 1878 the details of eighteen cases of aneurism of the thoracic and abdominal aorta treated by iodide of potash, and in all save four a considerable amelioration was obtained.

How are we to explain the action of the iodide in these cases? The problem is not easy of solution. We may, in fact, have to take into account the influence of syphilis on the development of aneurisms, an influence which has been well brought to light by Francis Welch.¹¹

In France, Lancereaux, Blachez, and Fournier have given us positive instances of aneurisms which have developed under the influence of syphilis. The latter produces an arterio-sclerosis, which modifies the elasticity of the blood-vessel and permits dilatation. But if in these cases the iodide treatment may oppose the syphilitic arterio-sclerosis at its onset, the action of the medicine is less easily understood when the aneurism has acquired a certain size. Hence other

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explanations have been sought. Chuckerbutty and William Roberts think that the iodide produces blood coagulation in the sac, which is more than doubtful, Anderson and Balfour maintain, with more probability, that the potassium salt acts chiefly by diminishing the intra-arterial blood-pressure in the sac.

For my part, the more I examine into the cases in which I have obtained ameliorations and even cures by iodide of potassium, the more I am convinced that this medicine acts, not on the sacculated aneurisms—the aneurisms with pouches—but on the true aneurisms—such as are simply cases of aortitis with dilatation of the vessel. You know that aortitis gives rise, like aneurisms, to symptoms of thoracic angina, and that, moreover, the diseased vessel is the seat of very energetic pulsations, which strongly suggest the existence of a large aneurismal pouch. Well, it is in these cases especially that iodide of potash so strikingly improves the symptoms, and may even result in cure. A recent fact which I witnessed along with my colleague Martineau, confirms me in this view.

However this may be, the facts are convincing, and before attempting other means, you should have recourse to the iodide treatment, which is attended with little or no danger, and here are some hints as to the mode of administration: Chuckerbutty was in the habit of giving five grains three times a day; Balfour administered ten grains three times a day. You can increase these doses, giving the iodide in this

way: You will give first three grains, and increase to five three times a day, then gradually add a grain or two to each dose till you have attained the quantity of thirty, then forty grains a day, and if the patient can bear it, you can push the iodide to ninety grains per day.

Do not forget, if you are to give the iodide of potassium a long time in these large doses, to direct the patient to take it in milk or in beer. The latter appears to be the best vehicle for the administration of this salt in a pleasant form, for it disguises well the taste, but you must direct that it be taken at meal time.

Do not forget, moreover, that the continued use of iodide of potash may entail a train of symptoms described under the name of *iodism*; you should leave off its administration in time, and take due account of the individual tolerance of your patients.

Do not abandon treatment by iodide of potassium till it has produced all its therapeutic effects, which will require the administration of this medicine for several months (Balfour says six months). You can make use of the following solution:

R Potassii iodidi, 3 iii.

Water, ʒ vi.

M. Sig.—A tablespoonful t. i. d.

Each tablespoonful contains fifteen grains of the iodide.

Take care from time to time to suspend the use of the medicament.*

Such are the medicines counselled in the treatment of aneurisms of the aorta. Thus far we have been occupied only with the local and general means; in the next lecture we shall study the more modern and more certain methods, which accomplish their curative purpose by penetrating the sac and determining the formation of clots and obliteration of the aneurismal pouch.

Remarkable results have already followed the electrical treatment of aneurisms, and the modifications which have been effected in the technical details have transformed an operation which was at first looked upon as a piece of surgical daring into a simple and relatively safe expedient, which deserves henceforth to have an important place in current medical practice.

* In the above prescription ℥i of syrup aurantii corticis may be substituted for ℥i of the water; it will then read: R Pot. iod., ʒiii.; syrup aurantii cort., ℥i.; aquæ ℥v. M. Leclerc, in order to disguise the taste of the iodide, advises to give it in rum and water.

Iodide of potash has been given in pastilles, in granules of 1 centigram each, in dragees of 10 centigrams, and in biscuits, each biscuit containing 10 centigrams. It has been injected subcutaneously (a bad method, likely to cause abscess), also administered per rectum. Ernesto Parona reports a case of aneurism of the arch of the aorta successfully treated by enemata of iodide of potash.

NOTES TO CHAPTER I.

1. Unknown to the ancients, internal aneurisms were not brought to notice till the end of the sixteenth century. Vesalius, in 1557, was the first to publish the fact of an aneurism diagnosticated during life, and verified by the autopsy. After him Baillou relates the case of an aneurismal tumor detected at the autopsy. Then came the labors of Lancisi, Val-salva, Albertini, Malpighi, Morgagni (1761), which gave a new light to the subject. Morgagni deserves especial credit for having summed up the labors of his predecessors, studied the formation of aneurisms, the alterations of vessels, the phenomena to which the presence of the sac gives rise, and the treatment to be pursued. But it was not till the researches of Scarpa (1804), who studied aneurisms in general, and those of the aorta in particular, those also of Corvisart in 1806, of Hodgson in 1815, and in particular, the discovery of auscultation by Laennec in 1819, and the labors of Bouillaud (1823), that aneurism of the aorta became well known; a subject which has since been so thoroughly elucidated. Among the numerous writers who have since devoted special labors to the subject, we may mention Stokes, Green, Gendrin, Bellingham, Thur-nam, Guthrie, Hope, Shekelton, Peacock, Kokitansky, Lebert, etc., etc. (a)

(a) Vésalius, in the Bonet sepulchretum anat., lib. IV, sect. 2, obs. 21. —Baillou, Epidémies et éphémérides (trad. par Yvaren, Paris, 1858). —Lancisis, De motu cordis et aneurysmatibus. Romæ, 1728. —Albertini, Animadversiones super quibusdam respirationis vitii (Bonon., Comm., t. I, 1751). —Morgagni, De sedibus et causis morborum. —Hunter (W.), History of Aneurism of the aorta (Med. obs. and inquiries, t. I). —Scarpa, Sull' aneurysma. Pavia, 1804. —Corvisart, Essai sur les maladies du cœur, 1818. —Hodgson, Traité des maladies des artères et des veines (trad. Breschet, 1819). —Bouillaud, Diagnostic des anévrysmes de l'aorte (Thèse 1823). —Laënnec, De l'auscultation médiate, 2e édit., Paris, 1826. —Greene, On the symptoms and Diagnosis of Aneurism and other Tumors in the cavity of the thorax (Dublin Journ. of Med. Sc., 1836). —Stokes, Aneurism of the

2. When you examine an aneurismal sac, you find that it contains two sorts of clots; the one hard, whitish, the other soft, colored, of little firmness; the latter occupy the centre of the sac, the harder, firmer coagula are in close proximity to the walls. Bellingham, in 1847, was the first to show the difference which exists between the soft and hard clots; the first forming when the blood is stagnant, completely arrested, while the second is the result of a slow, gradual deposition of fibrine on the walls of the sac, without any suspension of the arterial circulation. Broca, who in his great work has adopted the view of Bellingham, says: "The active (or hard) fibrinous clots are such as form under a vital influence, the passive (or soft) clots are such as form when the blood ceases to obey the laws of life."

The active clots alone are suitable for effecting the cure of aneurisms. They are stratified, formed of several thin, whitish, superimposed layers, whose firmness augments by degrees; they strengthen the walls of the aneurism, and by their presence favor the deposition of fresh layers of fibrine, and may thus bring about obliteration of the tumor. According to Broca, they are susceptible of a certain degree of organization, while the passive clots constitute an inert mass, not capable of undergoing transformation into living tissue, easily soften, disintegrate under the blood current, and disappear by solution, so that they cannot be counted upon to effect the cure of an aneurism; it is even possible for them by their presence to provoke inflammation and suppuration of the sac.

According to Broca, the clots are primarily either active

Abdomin. Aorta (Dublin Journ. of Med. Sc., 1844.—Gendrin, *Mémoire sur le diagnostic des anévrysmes des grosses artères* (Rev. médic., 1844.—Lebert, *Physiologie pathologique*, 1845.—Bellingham, *Dublin Medical Press*, t. XIX, 1848.—Rokitansky, *Ueber die wichtigsten Krankheiten der Arterien*, Wien, 1852.—Guthrie, *On the diseases and injuries of Arteries*. London, 1830.—Shekton, *Dublin Hosp. Reports*, vol. III., etc., etc.

or passive, and a passive clot cannot subsequently be transformed into an active clot. Richet affirms that the passive clots are first fibrino-globular, and that this transformation may come about by inflammation within the pouch, whether or not communication exists between the sac and the artery. Lefort also thinks that the transformation from passive to active may take place, and that the clot which forms upon the wall of a blood-vessel is not, as Broca taught, primarily fibrinous; it is composed of fibrine, of globules, and of serum; in opposition, however, to the opinion of Richet, he thinks that the transformation can only be effected when there is free communication between the artery and the aneurismal pouch. (a)

3. One of Broca's patients was a woman fifty years of age, with aneurism of the arch of the aorta, protruding by the side of the sternum, with marked pulsations and *bruits de souffle*.

The patient was subjected to low diet and absolute rest, then common collodion, whose retractile properties are well recognized, was painted over the tumor. It was thought, says Broca, that the steady compression which the retractile collodion might exert would have a favorable influence in disturbing the fibrine already deposited on the walls of the sac, and causing it to form the nucleus of new strata of fibrine. The next day the tumor was reduced two-thirds, and the following day the *bruits de souffle* were inaudible, and the beatings perceptibly diminished, and the pulse in the right wrist (corresponding with the aneurism) was unusually feeble; still later the pulse in both radials, which had been small and weak, be-

(a) Vanzetti, *Annali universali di medicina*. Milano, 1858 (Bull. de la Soc. de chirur., septembre 1857).

O'Bryen Bellingham, *Observ. on Aneurism and its treatment by Compression*, 1847.—Broca, *Traité des anévrysmes*, 1856.—Richet, article *Ancvrysm* Dict. de méd. et de chir. pratiques, 1865.—Lefort, article, *Anévrysm*e, Dict. encycl. des sciences médicales, 1866.

came normal. Broca believed the tumor to be situated on the anterior aspect of the arch, near the trunk of the innominate; before the application of the collodion the pulse was very weak on both sides owing to the interposition, in the blood current, of an enormous derivation pouch; then the collodion, in forcing back the tumor, determined compression of the innominate artery, and consequently enfeeblement of the right radial pulse; finally, clots having formed in the tumor, and these contracting, the vessel became permeable, and the disappearance of the sac restored to the pulse all its force on both sides (*Gaz. des hôp.*, 1878).

4. Tillaux's case was a man aged 54 years, who had an aneurismal tumor of the aorta, occupying the right border of the sternum, on the level of the second and third ribs. Tillaux compressed the tumor with his finger, and caused its disappearance; the aneurismal swelling returned when he removed the pressure. The patient did not suffer the least inconvenience.

Thinking that no harm could result from a repetition of this experiment, the professor called the attention of his class to it, pressing anew over the aneurismal tumor with his finger. He had hardly begun to make pressure when a singular change came over the patient; he tried to speak, but could not finish the sentence which he began; the mouth remained open, the eyes were vacant and glassy; the countenance pale, corpse-like and expressionless; the members were in a state of complete resolution. This happened at ten o'clock in the morning.

"We raised," says Tillaux, "the arms of the patient; the left fell inert. A few minutes afterward the paralysis passed from the left to the right side. The patient in half an hour regained consciousness so as to understand questions. At two o'clock, P. M., the hemiplegia on the right side began to go away, and in another hour the patient got up, though with difficulty, to urinate. The next day the paralysis was nearly

gone, but there remained complete aphasia. The aphasia, however, kept diminishing from day to day, to disappear altogether about the seventh day after the accident." (Bull. de Ther., t. 85, p. 232).

The patient died a month afterward, carried off by hemorrhage. The clot which was dislodged by the pressure, and which entered the circulation, must have been a passive clot and was resorbed. The autopsy did not show any sign of a clot in the cerebral arteries, which were perfectly normal.

5. The English surgeons practice total and continuous compression of the abdominal aorta, the patient being under chloroform.

The patient is kept for several days at rest, on low diet, and the bowels are well cleared out by a purgative the night before. As the operation is a painful one, designed to last several hours, anæsthesia during the whole continuance of the operation is necessary. A tourniquet is applied over the aorta, the pad being pressed down upon the artery about as firmly as possible by means of the screw, and the aorta flattened out against the vertebral column; the screw is turned until pulsations and bruits are no longer perceptible, and till the pulse in the femorals is gone.

During the entire operation, the lower limbs of the patient are wrapped in wadding and flannel bandages, and hot-water bottles are put to the feet to maintain animal heat.

The compression is continued, on an average for six hours, though some surgeons have prolonged it from ten to fifteen hours. Paget used to perform compression in three séances, with an interval of four or five days between, keeping up the compression not more than two hours and twenty minutes.

If threatening symptoms appear, such as obstinate vomiting, grave circulatory disturbances, collapse, the apparatus is loosened a little, or removed altogether.

When everything has gone on favorably, at the end of

the "sitting" the tourniquet is unscrewed, and the patient is allowed to come to himself, and is given a little broth, tea, or wine. To quiet the bowels, an opiate is administered.

Some surgeons claim a successful result from a single séance. If the beatings in the aneurism come back, the compression must be repeated on another occasion.

When the tourniquet is applied, the beatings of the heart are observed to become precipitate, the pulse cordy, frequent, intermittent; the patient is bathed in perspiration; countenance livid, respiration labored. Sometimes there is hæmatemesis, obstinate vomiting, sanguinolent, albuminous urine, copious diarrhœa. The legs become œdematous, present a livid tint, the temperature falls. At the same time there is numbness, with formications, anæsthesia and paralysis. All these symptoms rapidly disappear when compression is removed. Peritonitis may, however, follow in consequence of the length and severity of the operation. In three fatal cases reported by Woirhaye, the autopsy showed ecchymosis with ruptures of the viscera, and consecutive peritonitis.(a)

6. Langenbeck has practiced these injections on two patients. The first, aged 45, had had for several years an aneurism of the right subclavian, presenting violent pulsations which led him to fear rupture. He made the first injection, under the skin covering the tumor, of Bonjean's ergotin rubbed up in a little alcohol and glycerin, using three centigrams of the solution given below, now called Langenbeck's solution. From the second day a notable improvement was observed; the pain in the right arm preventing sleep was assuaged. Every third day a second injection was made, the quantity of

(a) Bryant, *Medico-chirur. Transactions*, 1872. Moxon et Durham, *Med. Times*, 1873, t. II. Greenhow, *Med. Times*, 1873, t. II, p. 78. Wheelhouse, *Med. Times*, 1864, t. I, p. 25. Woirhaye, *De la compression de l'aorte à l'aide de l'anesthésie dans le traitement des anévrysmes intra-abdominaux*, Thèse de Paris, 1876.

the ergotin solution being increased to three grains. From the 6th of Jan., the date of the first injection, 30 grains were employed. There was great amelioration and a manifest diminution in the beatings.

The second patient was cured after a single subcutaneous injection of 15 centigrammes of the solution made over the tumor. It was a man 42 years of age, who had for twenty years had an aneurism of the right radial; the tumor had attained the size of a walnut.

Langenbeck's solution is as follows:

℞ Bonjean's ergotin, 2.5.

Alcohol.

Glycerin, ää, 7.5.

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Schneider (Berl. Klin Wochenshr, No 36, 1868) reports a case of aneurism of the femoral cured by the same injection. Albanèse of Palermo has gone farther than Langenbeck, in making hypodermic injections into the tumor itself. The patient was a woman 36 years of age, who had an aneurism of the innominata as large as a mandarin orange, situated at the sterno-clavicular junction, and rising 4 centimetres above the clavicle; the beatings were isochronous with the beatings of the right radial. The right arm was œdematous; the fingers bluish; movements were difficult; the patient could not remain in a recumbent posture; felt pains in the shoulder; and had frequent fainting spells.

Dr. Albanèse made a first injection of 18 centigrammes, and the following day, a second of 20 centigrammes, but the patient was taken with dyspnoea, chilliness, imperceptible pulse; warm fomentations and the letting of four ounces of blood relieved these symptoms. The third day an injection of 30 centigrammes; the beating of the tumor became more feeble, and after the next day there was noticed an improvement in the breathing and in the movements. The fourth and

fifth days an injection was made morning and evening, a little more than a gram of the solution being used; notable amelioration, diminution of the tumor. To obviate the indurations of the pricks, the rectified spirit in Langenbeck's solution was replaced by distilled water. Six new injections were made in which 3.50 grammes were used. The patient quitted the hospital, not well, but in a better state than when she entered. (Dict. de Garnier, 1865.)

7. This is the résumé of these two cases: Vizioli having to treat a spontaneous sacciform aneurism of the brachio cephalic trunk, of three years standing, in a porter 51 years old, syphilitic, and a drunkard, ordered first iodide of potassium without success, then decided to resort to electricity. He employed a current of 60° to 65° by the galvanometer; the electrodes were applied over the tumor for 15 minutes once a week. At the beginning there was a sensation of smarting and of formication. After 5 or 6 séances, induration and sensible retraction of the tumor, and after 25 séances, the tumor, previously very large, bulged but slightly over an extent of 5 centimetres with feeble pulsations, without appreciable expansion.

The man was then able to resume his occupation, without augmentation of the tumor.

Martineau used external galvanization in a man 30 years old who had an aneurism of the right subclavian, dating back 5 years, and forming a rounded tumor six inches in circumference, extending to a finger's breadth from the clavicle. After the first operation, as after the following, there was a sensible retreat of the tumor, but it soon resumed its original size. The séances, infrequent, were prolonged for 50 minutes, and produced a slight cutaneous erythema, and some formication. After six months, the tumor was found considerably diminished in size; it had become hard, with feeble pulsations, without expansion; the patient was able to resume his occupation (Acad. de Med. de Naples, 1876.)

8 and 9. Two notes of the author in reference to two now obsolete internal remedies are omitted to give room for a brief abstract of Dr. Timothy Holmes' valuable article in the *Lancet* "On the Surgical Treatment of Aneurism."

The main propositions which Dr. Holmes endeavors to establish are as follows:

1. That aneurisms of whatever form and however near the heart they may be, ought not to be regarded as incurable, but should be made the object of definite, methodical treatment, internal and external.

2. That there is definite proof, from pathological anatomy and from surgical experience, of the curative influence of Brasdor's operation in innominate aneurism, and of its beneficial effects in some cases of aortic aneurism.

3. That arteries may be successfully tied and obliterated without their continuity being interrupted; and that this modification of the ligature, whilst affording much security against secondary hemorrhage, and thus much diminishing the danger of the operation in general, may very probably in future enable surgeons to deal successfully with cases in which it may be necessary to tie the first part of the subclavian (whether on the distal or proximal side of an aneurism) or the innominate artery.

4. That galvano-puncture may be used with at any rate temporary benefit in thoracic aneurism; that its use is not so dangerous as to render further trials of it inexpedient; and that there is good hope that the method may be so far perfected as to make it a safe and regular plan for the treatment of thoracic, subclavian, and other forms of aneurism.

5. That many cases, such as those in which ligature of the artery near to the heart has been resorted to for the cure of subclavian and subclavio-axillary aneurism, may be made amenable to improved methods of pressure.

6. That aneurismal tumors situated even as high as the lower part of the abdominal aorta, those of the mesenteric and

other branches of the aorta, and of the iliac arteries, may be treated with success by rapid coagulation of blood under pressure; but that this method is a dangerous one, and should not be used until internal treatment has failed.

7. That there are cases of abdominal aneurism in which Mr. Symes' suggestion of reviving the old operation is worthy of further trial.

Numerous instances are on record in which persons affected with aneurism of the arch of the aorta have, either spontaneously or as the result of medical treatment, been restored to a condition of tolerable health, have lived for a long period of time, and have ultimately died from other causes.

But allowing that it is difficult to obtain complete consolidation in an aneurism of such large arteries, and that the cure when obtained affords no guarantee for permanent recovery, it is still evidently our duty to attempt the treatment of the disease if cure is possible—nay more, if even alleviation and the prolongation of life is possible. Now this latter is not only possible, but easy. Judicious medical treatment, with rest systematically enforced, is almost always followed by temporary improvement. And in aneurisms which are growing in any definite direction, and whose growth in that direction threatens important organs, or is likely to lead to rupture of the sac, there is always a chance of stopping such growths for the time, and so possibly preserving the patient's life. I venture to say that this point is hardly enough considered. We think so much of whether an aneurism can be completely consolidated or not, that we are apt to forget how often its partial consolidation only is followed by such an alleviation of the symptoms as amounts almost to temporary cure.

It being admitted that cases of growing aneurism, affecting the thoracic aorta, or the innominate, or the roots of the left carotid or subclavian within the thorax, or affecting the aorta and one or more of its primary branches simultaneously,

are not to be regarded as wholly incurable, the next question is, What are the means hitherto devised for their treatment? They are three in number—namely: internal or medical treatment; the distal ligature or Brasdor's operation; and galvano-puncture.

I pass over the injection of ergotine into the cellular tissue around the sac, which has been said in a foreign medical journal to have been recently recommended by Langenbeck, since that distinguished surgeon has not as yet published his own version of the proposal. The theory of the matter as explained by the journalist seems to me utterly unintelligible, but I have made trial of the method in two cases, with results which were perfectly nugatory; and I have not succeeded in discovering that the experience of others has been more satisfactory. I pass over, also, the plan of introducing a mass of fine iron wire into the sac, as practised by my late friend, Mr. Moore; since I think no one will deny that it is not more certain than galvano-puncture, while it is far more likely to cause inflammation of the sac-wall. Since Mr. Moore's death, the operation, I find, has been twice repeated—namely, by Dr. Murray, of Newcastle, in a case which terminated by suppuration of the sac; and by Mr. Dumville, of Chatham, without any definite result. The sac has also been transfixed with fine needles with the same object.

With regard to the internal or medical treatment I shall say very little, since I could add nothing to the admirable exposition lately given of it by Mr. Jolliffe Tufnell. The extreme bleedings recommended by Valsalva have been discarded as calculated to excite the heart to irritable action and to impoverish the blood, thus both impairing nutrition, and so endangering the rupture of the sac, and rendering the blood less fit for coagulation. But the valuable parts of Valsalva's treatment have been retained and methodized. The patient is confined strictly to the recumbent position during a very long

period, the most minute precautions being taken to ensure that he can be kept without raising himself once from the bed during many weeks; his food is restricted to the smallest quantity of nutritious solids that can satisfy his appetite, and his drink to the very smallest quantity which can be tolerated. Much stress is justly laid by Mr. Tufnell on this latter precaution, and Dr. Sibson also testifies to the extreme importance of restricting the quantity of fluid to the lowest possible point. The medical treatment of the case otherwise consists almost exclusively in the administration of such narcotics as may be absolutely necessary to calm pain and procure sleep, and such purgatives as may be required to keep the patient comfortable, and avoid all straining in defecation. The great object is to keep the pulse at an equable rate, a little over 60, and free from all excitement. Though Valsalva's extreme bleedings are avoided, a very small venesection may be occasionally serviceable with this view. I would strongly urge any surgeon undertaking for the first time the care of a case of internal aneurism to study Mr. Tufnell's invaluable little pamphlet, which shows how much may be done for the relief of conditions usually regarded as hopeless, and by how simple, safe, and painless a method.

Brasdor's operation rests upon a sound pathological basis, so far as this—viz., that we have preparations in sufficient number to prove to us that impaction of clot in the distal end of the artery as it leaves an aneurismal sac is naturally (I do not say necessarily) followed by obliteration of that portion of the sac which is distended by the stream of blood formerly passing up the closed artery; that such obliteration, even when it stops short of the consolidation of the whole tumor, may suffice for the removal of all symptoms of the disease; and that precisely the same effect would follow naturally (but here again I do not say necessarily) on the distal ligature of the same vessel. This being granted, it follows that there are some cases of innominate aneurism which may be completely cured by Brasdor's operation.

The condition of an artery immediately after ligature varies much. In some cases an artery which, like the carotid, runs a long course without branches, will be filled with clot from end to end (as in Dr. Wright's case); in others, as in Sir W. Ferguson's, no clot whatever will be contained in it. And the same thing is seen at a later period. Sometimes after division only a very small part of it is obliterated; at others the whole artery between the nearest considerable branches is converted into a solid cord. This must have its effect upon the obliteration produced in the tumor by the distal operation. If the blood is so indisposed to coagulate that after the ligature of the carotid no coagulum forms in the artery, it is probable that coagulation will go on but slowly or imperfectly in the sac. In those cases, on the other hand, where the artery is completely filled with coagulum, the blood in the sac will also show a strong tendency to coagulate: first the ordinary blood-clot will form, and this will subsequently become laminated, as happens after the ordinary operation.

It seems doubtful whether we can entertain the same expectation of complete obliteration of the sac from distal obliteration of the arteries when the tumor is partly aortic. An interesting case is here in point, communicated to the Pathological Society (Trans., vol. xx, p. 118) by Dr. Douglas Powell. In this case an aneurism, arising from the arch of the aorta, and involving that artery from above the origin of the innominate to below that of the left carotid, implicated the innominate in its whole extent, and it must have been impossible during life, as far as I can see by the recorded symptoms, to have diagnosed this from a purely innominate aneurism. After death it was found that the carotid artery had been converted into a solid cord from end to end. The right subclavian was also obliterated at its origin, though this, as I am informed by Dr. Powell, must have occurred very shortly before death, since pulsation in the right wrist, which had been absent during the

presence of a considerable effusion into the pleural cavity, returned on its removal, and was perceptible till within a few days of death. Here, however, the circulation through the sac was kept up by the stream of blood traversing the aortic and left carotid orifices, and only a little laminated clot was found at its upper part. This deposit of clot was connected in all probability with the coagulation of blood in the carotid artery. And the analogy of the preparations of innominate aneurism above referred to justifies me, I think, in saying, that, in an aortic aneurism also, the obliteration of any of the arteries, such as the right or the left carotid, which lead directly out of the sac, will be followed by consolidation in that part of the sac which is distended by the stream of blood formerly passing up the obliterated vessel.

There is, then, sufficient pathological evidence to show that an innominate aneurism may be obliterated by the obstruction of its two distal orifices, and to prove generally that the obstruction of an artery as it leaves an aneurismal sac will in all probability be followed by a deposition of firm laminated coagulum in the portion of the sac connected with the obstructed artery, whereby the growth of the tumor in that direction will be stopped. Now, we must always bear in mind that it is not usually the existence of an aneurism, however large, which is dangerous to life, but the growth of an aneurism, however small, in some definite direction. To stop the growth of a small innominate aneurism towards the trachea, or of a small aortic aneurism towards the recurrent laryngeal nerve, would preserve the patient from a danger which cannot be over-estimated, and would be worth much more risk than is involved in tying the common carotid or the subclavian artery. Again, to line any portion of the sac of an aneurism where it is growing and threatening to burst, or compress important parts, is surely a reasonable object for an operation, even if the operation involves danger, and if the rest of the sac remains unconsolidated.

10. IODIDE OF POTASSIUM (K I) is obtained by treating caustic potash with iodine in powder; the resulting product is calcined with charcoal to decompose the iodate. It crystallizes in cubes, is white, of piquant, salty, acrid, disagreeable savor, melts at a red heat without decomposition; is anhydrous, slightly deliquescent, turns yellow when exposed to the air, is soluble in water and alcohol at 90°. The aqueous solution turns blue on adding starch, if treated by a few drops of nitric acid. Iodide of potassium is often adulterated with carbonate or iodate of potash, with chloride of sodium or potassium, and with bromide of potassium.

Action.—Rubbed upon the skin, iodide of potassium produces a slight irritation, smarting, erythema, and sometimes an acneiform eruption. In contact with mucous membranes, it also provokes a slight irritation, a little angina, and some pain in the stomach. Taken in small doses, it slightly stimulates appetite, and may constipate the bowels. An acceleration of the circulation is noted; the pulse is more rapid and full; there is some cephalic congestion, with lachrymation and mild coryza.

Given in large doses, or even in feeble doses to susceptible persons, these symptoms acquire a great intensity; there is severe cephalic congestion with a feeling of heaviness in the head, pain at the root of the nose and in the region of the frontal sinus; sometimes the cephalalgia is intense; there is swelling of the eyelids with flashes of light before the eyes; there is lachrymation, and an abundant flow of sero-mucus from the nose, in short all the symptoms which constitute *iodine poisoning* or iodism (Lugol.) Coindet and Ralliet have also noted a sort of cachexia or constitutional iodism, supervening even when the salt has been given in small doses, and characterized by rapid emaciation, an excessive appetite, and nervous palpitations.

Iodide of potassium almost always augments the men-

strual flux, hence it has been proposed in amenorrhœa (Trousseau, Coindet, and others); it may also promote hæmoptysis in the tuberculous, and cause wasting of the mammæ and testicles, (Moisisowiz).

Iodide of potassium is eliminated by the kidneys (hence the more abundant diuresis, and even the renal inflammation and consecutive albuminuria which has occasionally followed the prolonged or excessive use of the salt), by the salivary glands (ptyalism), by the pituitary membrane (coryza), by the glands of the skin (various eruptions), etc.

According to Gubler, the most important effect of iodide of potash is the acceleration of the movement of denutrition. He thinks that "by means of the fluidity which it communicates to the blood and to other liquids of the economy, or by some other means, iodide of potassium favors the resorption of liquids or of interstitial plastic products, at the same time as that of all the residua of organic disintegration, and directly accelerates disassimilation. The secondary effects are increase of the need of reparation, a more rapid organic reparation, and, it may be, an advantageous modification in a morbid diathetic condition."

Iodide of potassium is given in potion, in syrup, in pomade, and in glycerole (8 parts iodide potassium to 35 of glycerine). The dose is 5 to 30 grains or even more three times a day. (Trousseau used to give drachm doses of this salt.)

Basing themselves on the fact that iodide of potassium is eliminated in the milk, some authorities have advised its administration to milch cows, and the giving of this milk to persons affected with syphilis, etc. (Clinical Therapeutics," part III, p. 324 et seq.)

11. According to Dr. F. Welch, the syphilitic virus is a common cause of aneurism of the aorta, taking the precedence, even of rheumatism and alcohol. It is to compression of the thorax by the uniform, which renders the exciting causes more

active, that is due the very great frequency of aneurism among the soldiers of the British army.

Welch, on examining 34 cases of aneurism of the aorta with autopsy in men aged 32 years and upward, after twelve years of service and thirteen months of sickness, has observed that half the subjects were plainly syphilitic, presenting divers lesions: primary manifestations with cutaneous eruptions, glandular affections, periosteal nodes, gummata, etc.

Moreover, according to Dr. Welch, the anatomo-pathological lesions confirm his view, for besides the simple patches of atheromatous or fatty degeneration of the inner coats of the vessels, there is an active lesion, a proliferating endocarditis, having for its term the formation of an aneurismal sac; now this latter lesion generally coincides with syphilis, and sometimes with rheumatism and with alcoholism.

Out of 117 cases of these various lesions the English surgeon shows that 46.1 per-cent. were syphilitic; in 56 cases of fatal syphilis, he found in most of them nodules in the aorta, and in 18 the vessel had undergone more or less pronounced dilatation. Out of 106 autopsies of subjects who were exempt from syphilis, Welch found only 5 cases of aneurism of the aorta which were referred to rheumatism or to intemperance. (Reports of the Royal Medical and Surgical Society, Nov. 23, 1865.)

CHAPTER II.

TREATMENT OF ANEURISMS OF THE AORTA BY ELECTRO-PUNCTURE.

SUMMARY.—Introduction of Foreign Bodies Into the Aneurismal Pouch—Acupuncture—Introduction of Needles, Fine Wire, or Horse Hair—Method of Baccelli—Introduction of Watch Springs—Electrolysis—Method of Ciniselli—Indications and Contra-Indications for this Method—The Operative Procedure.

In the last lecture I described the various means which have been employed in the treatment of aneurisms of the aorta, and showed you that with the exception of compression in aneurisms of the abdominal aorta, there remain as modes of treatment which are of proved utility, only iodide of potassium and ice. I intend to-day to speak about other methods which consist in the introduction of foreign bodies into the aneurismal sac.

Velpeau was the first, in 1830, to recommend and practice the introduction of fine needles into surgical aneurisms,* while still later Moore, instead of needles,

*Velpeau practiced acupuncture, aided by galvanism, for a popliteal aneurism; he plunged several needles into the tumor, and left them there a week. The operation was unsuccessful; a hemorrhage obliged the surgeon to tie the crural; this was followed by gangrene of the member, and death of the patient.

inserted a certain quantity of fine steel wire. (*) Levis, of Philadelphia, has modified the procedure by substituting horse hair for the steel wire; (†) in a huge aneurism of the subclavian he introduced twenty-four feet of horse hair. Bryan followed the same method

Benjamin Phillips claims to have cured an aneurism of the parotid region in 1831, by acupuncture.

A propos of acupuncture, it is well to recall the attempt of Everard Home, who conceived the idea of applying heat to assist the coagulation of the blood. His procedure (but once employed) consisted in inserting an acupuncture needle into the aneurismal pouch; the end protruding externally was heated. The case was one of aneurism of the external iliac. Three attempts at caloripuncture were made; in the third the pulsations ceased completely, and did not return. The patient, who barely escaped gangrene of the member, died 46 days afterward of some unknown affection.

(*) Moore introduced into an aneurism of the aorta bulging through the intercostal spaces, a small pointed cannula, and passed through it into the sac, 26 yards of steel wire. Immediately the pulse fell from 116 to 92; the pulsations of the tumor in great part disappeared and its volume diminished. In the evening the pulse was 78. The next day there was intense precordial pain, violent beatings of the heart, chills, and death took place 132 hours after the operation. At the autopsy it was found that the sac was in great part filled with a fibrinous coagulum adherent to the walls, and enveloping the coils of the wire. (Brit. Med. Jour. 1864.)

(†) R. J. Levis thinks that the horse hairs, which he introduces one after another into the sac, undergo decomposition but slowly, and cause neither irritation nor suppuration.

in an aneurism of the popliteal. Save in the case of Moore's patient who had an aneurism of the aorta, all the other cases were surgical aneurisms.

It is to Baccelli, the eminent surgical professor of Rome, that is due the first application of these methods to the treatment of aneurisms of the aorta. He first followed Moore's procedure, introducing steel wire into the tumor, then he adopted the modification advised by Montenovesi, viz.: the substitution for the wire of a watch spring,* and in a communication to

and that they are capable of opposing to the blood current an obstacle sufficient to give rise to the formation of clots.

In the case of an aneurism of the subclavian, he introduced 24 feet 9 inches of horse hair and noted that the beatings in the tumor had diminished in intensity, while the radial pulse had become more feeble; the tumor was firmer. A month after, without the supervention of any inflammation or any other untoward symptoms, the pulsations had ceased in the sac, in the axillary and the radial, and the tumor had become harder. (Phil. Med. Times, Oct., 1873.) [Dr. Horace Dobell (Braithwaite, Part LXXV) recommends the introduction into the aneurismal sac of melted spermaceti, which can easily be injected through an aspirator, after the sac has been emptied by the same instrument. It solidifies in mass, is unirritating and effectually blocks the artery above and below the aneurism. This treatment, of course would be contra-indicated in aneurisms of the large blood vessels. Tr.]

* Montenovesi, in a case of thoracic aneurism, made a capillary puncture into the sac, which enabled him to introduce a watch spring. The solidification of the tumor made itself manifest by a diminution of the pulsations and the volume of

the Congress of Geneva he showed the advantages which may be derived from this method. This is the *modus operandi*.

Having remarked that in animals it is less dangerous than one would think to plunge trocars of small size into the interior of arteries, Baccelli inserted a fine trocar into an aneurism of the aorta, and introduced through the cannula a very small watch spring, which was allowed to remain in the sac. In one case in particular, he passed in a watch spring one metre ten centimetres in length. The two patients whose cases he has reported, ' having succumbed some time after the operation, it was found at the autopsy that clots had formed around the coils of the watch springs.

Baccelli has limited to certain cases the application of this hazardous method, and has specified the clinical symptoms which constitute the indications and contra-indications for the operation and the kind of aneurisms to which it is applicable. It is necessary, he says, that the aortic aneurism shall be of the ampullary kind (a pouch-like dilatation with a narrow neck), that it shall not be too near the heart, and that the orifice of communication with the main artery shall be small.

the tumor, but one of the ends of the watch spring soon protruded externally, and despite all attempts at extracting or forcing it back, death ensued the twenty-fifth day after the operation. (Dict. de Garnier, 1874.)

I have nothing to say in the way of approval of Bacelli's method, which must be shown by further trials to be attended with better results than heretofore before it will come into practice, or before practitioners will regard it as any thing but a dangerous mode of treatment, and pass on to another method which also comes from Italy, and of which Ciniselli is the chief exponent; I allude to the electrolytic treatment of aneurisms.

The first application of electricity to the treatment of aneurisms was made by a French physician. Pravaz first advised galvano-puncture, then it was attempted in 1837 by Becquerel, then by Liston and Gerard in 1838, afterwards by Phillips, but it was Pétrequin, of Lyons, who first, in an aneurism of the temporal artery, triumphantly demonstrated the curative efficacy of the operation, obtaining coagulation of the blood and obliteration of the aneurism by passing an electrical current through a needle plunged into the tumor.

From 1845 to 1849 Pétrequin multiplied his observations, and for some time this method had considerable popularity, but it was exclusively limited to external aneurisms, and it is to Ciniselli that belongs the honor of being the first to lay down the rules for the application of electrolysis to the treatment of aneurisms of the aorta.

At the same time, it is only fair to remark that Ciniselli was not the first actually to perform electro-

puncture of aortic aneurism. Several hardy attempts had been made before; thus it was that in 1849, as my master, Bernutz has told me, Piednagel plunged two needles into a voluminous aneurism of the aorta belonging to a workingman of Charrière, and these needles served as conductors to an interrupted current from a Breton battery; moreover, Duncan, of Edinburgh, in 1865 passed by means of needles a constant current into an aneurism of the aorta.*

The professor of Cremona did, moreover, but fol-

*The patient was a man forty-five years old, who had had since 1863 pains in the shoulders and chest, and in December of that year a pulsating tumor made its appearance in the anterior region of the thorax. Galvanism was applied December 3 by Dr. Wright under the directions of Prof. Duncan, and in presence of Prof. Simpson. The patient was seated on a sofa; the needles were introduced at the base and on the two opposite sides of the tumor; the current was kept up three quarters of an hour with four elements of Bunsen without producing any pain; the pulsations became less intense. The currents were alternated and the application was continued an hour and ten minutes. The pulse became small and the patient fatigued, and he was removed to his bed.

The night passed without any untoward complication. The next day the pulse was down to 80. The needles were again introduced, and a current from eight elements was applied; the pulsations became feebler. This was the last application; the patient died suddenly on the 11th.

At the autopsy the sac was found ruptured at its upper part, and contained a hard, compact and laminated clot. (Edinburgh Med. Jour., April, 1866).

low out and turn to practical advantage the discoveries given to the medical profession in the remarkable work of Strambio, a work which sums up the experimental researches of a commission appointed in Italy in 1846. This commission, having for its object to study the coagulating effects of constant currents, was composed of doctors Strambio, Quaglio, Tizzoni and Restelli, and the conclusions at which they arrived have been given in the *Gazetta Medica di Milano*. By numerous experiments scientifically conducted and accurately observed, Strambio showed that galvanic currents have a manifest action on the formation of clots, but that in this regard, it is important to distinguish positive from negative currents. While the former bring about rapid coagulations, the latter cause no coagulation at all. Experimentation shows that in living animals, one may rapidly obtain obliteration of the largest arteries by electro puncture, but that this coagulation is not always immediate, and that it is necessary to wait a day or two to see it effected. It was by taking as his basis these researches, that Ciniselli had the courage first to apply electrolysis to the treatment of aneurisms of the aorta. He plunged into the aneurismal sac several fine needles, through which he passed the electric current into the interior of the sac.

For a long time it was only in Italy that this method was practiced; then it was introduced into Europe and America, and we have seen it successively

applied to the treatement of aneurisms in Europe, by Anderson in 1870, by Charlton Bastian in 1873, by Brown in 1873, in America by Bowditch in 1876, and in Germany by Frantz Fisher, in 1875. (a)

But before going further, and showing the results which may be expected from electrolysis, it is impor-

(a) Ciniselli, Sulla elettro puntura, nella cura degli aneurismi. Cremona, 1856; Sul processo operativo dell'elettro puntura nella cura degli aneurismi dell'aorta (Annali universali di medicina, Nov. 1870); Aneurisma dell'aorta trattato coll'elettro (Giornale della R. Accademia di Torino, 1873); Sopra alcuni aneurismi dell'aorta toracica osservati dosso, 1870 (Galvani, 1873, Gennaio); Sulla elettroliti considerata negli esseri organizzati, ecc. (Galvani, 1874, fasc. 4 et 5); Dimostrazione di alcuni coaguli ellectrici trovati in aneurismi trattati coll'elettro puntura e presentaziome dei relativi pezzi del dottor Ciniselli (Estratto dal retocouto degli argomenti scientifico pratici dalli trattati Comitato medico cremonette, nel 1876.—Cristoforis, Annali universali di med. e chir., April 1875.—Franzolini, Giornale venete di sc. med., Jan. 1877, p. 3.—Guido-Bini, l'Imparziale, 15 May 1877, p. 257.—Ferdinando Verardini (de Bologne). Alger médical, Nov. 1877, p. 340.—Anderson, Lancet, 13 June 1870 (British Med. Journ., 1875; British Med. Assoc., 1875; Journ. de Thérap., 1875, p. 728).—Charlton Bastian, British Med. Journ., 22 et 29 Nov. 1873, p. 594 et 620; Rev. des sciences méd., t. III, p. 695.—Brown, The Lancet, 24 April 1873, p. 264; Rev. des sciences méd., t. III, p. 697. Henry I. Bowditch, Philadelph. Med. Times, Feb. 1876; Journ. de Thérap., 1876, p. 681; The Boston Med. and Surg. Journ., Jan. 1876.—Frantz Fisher (de Pforzheim), Berl. klin. Wochenschr., Nos. 45 et 46, Nov. 1875, et Rev. des sc. méd., t. VII, p. 559.

tant to discuss here at length the mode of operating, and the indications and contra-indications for the operation.

I must first, however, show you by an experiment the peculiar action of electricity on albuminous liquids. You see here this test tube; it contains a quantity of white of egg. Through the stopper of the test tube we pass two needles which dip into the albuminous liquid. One of these needles is in communication with the positive, the other with the negative pole of a Gaiffe battery of twenty-six cells.

At the moment of the passing of the current, you see all around the negative pole a whitish fleecy cloud which consists of bubbles of gas enveloped by albumen. Several minutes have now elapsed, and you see this flocculent mass rise to the surface of the liquid; around the positive needle there is a coagulum of an ochreous (yellowish red) color which thickens and soon forms a dense trail which falls to the bottom of the test tube.

What has happened? The alkaline salts in combination with albumen have been decomposed. At the negative (so-called alkaline) pole the basic element is set free; this in presence of water absorbs oxygen and disengages hydrogen. At the positive (so-called acid) pole, oxygen is set free, which oxidizes the surface of the needle, and the acid, which dissolves in part this oxide, is also liberated at this pole, and it is the presence of this acid which secondarily causes the coagulation of the albumen.

If you examine the needles, you will in fact see that the needle which corresponds to the positive pole is rusted, has lost its silvery look, and its polished feel.

This experiment gives you a pretty good idea of what you will be likely to accomplish in the galvano-puncture of aneurisms. We have here several points to study; the nature and intensity of the current, the number of needles to employ, and the kind of needles.

Ciniselli is in the habit of passing the current in the following way. He connects one of the needles with the positive pole of his battery, and he attaches the negative pole to a plate of metal, which he places near the aneurism. At the end of five minutes he transposes the current, and while he applies the positive pole to another needle, he puts the negative pole in connection with the first needle, and thus with the needles inserted in the tumor he repeats the operation with each needle in such a way that each receives, for five minutes, first the positive, then the negative current. Ciniselli attaches a great importance to this double application of the current, and thinks thus to render the coagulation more active. He thinks that he also avoids by this means the caustic action determined around the needle by the passage of the positive current.

Ciniselli's method has been followed in Italy by almost all electro-therapists who have operated by galvano-puncture since his first publication. In other

countries, doubts have been held respecting the utility of the passage of the negative current into the interior of the tumor, and Anderson who sums up the practice of English electricians, protests against the use of this current as being dangerous. He declares that the negative current plays no part in the formation of the coagulum, and that its action cannot but be detrimental. I agree entirely with this view, and in the application which I propose to make of this method, while following the most of Ciniselli's rules, I shall part company with him on this point, and take sides with the English electro-therapeutists.

It suffices to take note of what occurs in the test tube, to be impressed with the danger of what may result from the application of the negative current. You remarked the abundant disengagement of gas at the extremity of the needle. Enough is in fact set free to burst an egg shell, if the two electro-puncture needles were thrust into an egg. Well then, the same phenomenon will take place in the blood, and with no little intensity, considering the quantity of gas which this fluid contains, and the presence of these liberated gases may give rise to two kinds of accidents; either these gases may pass into the general circulation, and determine fatal embolisms, or they may accumulate in the sac, and cause it to burst under their pressure. I well know that, being formed in the blood, they may be reabsorbed. But, as it has been proved that the negative pole has no part in causing coagulation of

the fibrine, and in view of the possible dangers which may attend its employment in the way Ciniselli advises, I am persuaded that it is better not to have this pole in immediate communication with the interior of the tumor.

As early as 1861, Tripier had shown the advantage of applying the negative pole to the outside. He recommended to pass only the positive current through the needle, while the negative pole, terminating in a metallic plate of some size, was applied in the neighborhood of the tumor. We shall follow this method, and our negative pole shall be constituted by a flexible plate of metal covered with chamois skin, which shall be kept moist, and placed on the right side of the thorax.

Ciniselli has moreover rightly insisted on the intensity of the current, and especially on its chemical action; he has prescribed the number of cells and the form of the apparatus which bears the name of its inventor.

The battery which Ciniselli employs is a galvanic apparatus composed of 24 cells, placed in two rows. The elements are formed of two plates, one of copper and one of zinc, separated by a double sheet of paper destined to become impregnated with the excitant liquid, which is a one-thirtieth solution of sulphuric acid. A glass vessel, placed above the elements, is destined by the intermediation of glass syphons, to keep the elements continually wet, and thus maintain the constant intensity of the current. Another recipient placed below the elements receives the liquid which escapes.

In aneurisms of the aorta, Ciniselli employs from 15 to 20 elements, sufficient, in fact, to produce two cubic centimeters and a half of gas every five minutes.

We shall employ in this instance the Gaiffe machine, with which you are acquainted, and which presents this great advantage, that by means of the manipulator, you may augment at will the force of the current, and reduce it to zero if necessary. You understand the utility of this manipulator or collector, which enables you by reason of its graduation, to pass successively the current through each needle, without causing the patient to feel the shock which would result from a sudden break in the current. ^a

But the most important service rendered by Ciniselli is that of having determined with precision the chemical force of the current. He says, in fact, that in order to obtain a favorable result, the Voltaic apparatus should give off 25 cubic millimetres of gas every five minutes from the decomposition of water acidulated with one thirtieth part of commercial sulphuric acid. Here the voltameter ^b which Gaiffe has so ingeniously constructed will enable one to put himself in conditions identical with those prescribed by Ciniselli.

This apparatus is, as you see, composed of a long glass cup containing acidulated water; the two poles of the battery pass down to the bottom of the glass tube or cup (see Fig. 5), and at the upper part of the tube is a scale which tells the quantity of

gas produced in a given time. It is, then, quite easy, by increasing the number of cells, or by making use of the apparatus described in physics as *rheostat*, which permits increase or diminution of the force of the current, it is quite easy, I say, to regulate the electrical discharge so as exactly to obtain the conditions laid down by the Italian authority.

We have now passed in review the nature of the current, its intensity and the battery destined to furnish it. There now remains an important question for consideration, that of the needles. These should be fine, and Ciniselli and Anderson rightly insist on this point; moreover, to avoid as far as possible the caustic action of the positive current, they should be coated in their upper part with some protective enamel. Every body is agreed as to the necessity of this, as well as respecting the kind of metal of which the needle should be made, and which should be of wrought iron, so as not to break while penetrating the tumor.

As for the kind of metal, the little experiment just made shows the advantage of the needles being made of iron. You saw the cloud which was produced in the albuminous solution at the extremity of the positive needle present a brownish tint, owing to the presence of a salt of iron, probably a proto-chloride; now these chlorides, like all the other salts of iron, may have an action in promoting coagulation, and this is a consideration which is of no light account.

When the needles are inserted in the tumor, they necessarily undergo movements corresponding to those in the aneurism, and we have seen what takes place in physiological experiments, when with the intent of measuring the beatings of the heart, physiologists make use of acupuncture needles plunged into the walls of the heart. It is important, then, that the wire destined to connect the needle with the battery should be light enough and elastic enough so as not to determine too violent tractions on these needles. Gaiffe has accomplished in an ingenious manner the conditions that these conductors ought to fulfill. See, in fact, this conducting wire, which is so fine, and is insulated with a covering of silk; it is of spiral turn, presenting an extreme lightness conjoined with a considerable elasticity.

Having settled the question of instrumental appliances, it remains to consider the number of needles to introduce, and the point where the insertion should be made. The number is variable, and depends on the extent of the sac and the ease with which it may be entered. But you readily understand that it will not do for the needles to be entered too near the aorta, and what must be avoided at all cost, is the production of a coagulum in proximity to the general blood current, on account of the danger that such clot may enter the circulation and cause fatal embolism. Ordinarily, and the first time especially, only two or three needles are introduced, and the number in in-

creased at the following séances. I say *following séances*, for generally the operation does not give complete results the first time, and one is obliged again to have recourse to electro-puncture, and more or less frequently, at séances of from three weeks to a month apart.

When once your equipment for the operation is complete, you will have to take account of the conditions which the patient should fulfill in order to derive from acupuncture the most advantage. In a word, you have now to ask what are the indications and contra-indications for the method. Here, again, it is to Ciniselli that we have to look for instruction, for his large experience and brilliant success have enabled him to speak with authority on this subject.

It is expedient (and this an important condition), that the aneurism shall be in the form of a distinct pouch appended to the aorta and communicating with it by a narrow orifice; and the narrower the better, for the greater will be the chances of obtaining coagulation. It will not do, moreover, to attempt to operate on an aneurism which gives off a voluminous artery, for what you will have to fear, will be the passage of emboli into the general circulation and the sudden arrest of the arterial blood flow in some important region of the body. Add that the more recent and the less voluminous the aneurism, the greater are the chances of success. On the other hand, the larger the tumor, and the more it bulges outside

of the thorax, the less likely are the remedial measures to be efficacious.

Soundness of the heart is also an important condition of success. When there is aortic insufficiency, a frequent and almost necessary lesion when the aneurism is seated in the first portion of the arch of the aorta, the likelihood of cure is very much lessened, and even if the condition of the aneurism be ameliorated by the operation, the patient still has a valvular imperfection which of itself may cause death. The integrity of the rest of the arterial system is no less necessary, for the sounder the arteries, the greater is the prospect of cure. Lastly the robustness and the not too advanced age of the patient are favorable conditions of which account should be made.

Therefore, gentlemen, before thinking of resorting to the electrical treatment of an aneurism, you should make an attentive examination of your patient, and employ every diagnostic means in your power in order that you may be able to define with almost mathematical certainty the limits and extent of the tumor. Thanks to the means of investigation actually in our possession, we are able to attain sufficient exactness of diagnosis. Besides the information derivable from percussion, you have the help of auscultation which is of especial advantage when made with the binaural stethoscope, which enables you to limit exactly the seat and intensity of the murmurs; and it is at the point where you hear these bruits at

their maximum intensity, that you will locate the orifice of the aneurism. The examination of the heart will enable you to judge of the diameter of this orifice. Baccelli, in fact, has established this law, that whenever the opening into the aneurism is of small size, the heart is not augmented in volume, while, on the contrary, this organ undergoes considerable hypertrophy if the orifice is large.

In order to determine the point where the aneurism takes its start, you will make use of Marey's registering apparatus, which indicates, simultaneously, the pulsations of the heart, those of the sac, and those of the different arteries which are given off from the arch of the aorta. In comparing these tracings, you will be able to detect the modifications effected in the circulation in the course of the arteries, and thus judge as to the point where the aneurism is seated. François Franck has insisted with emphasis on the value of these modifications of the radial pulse in the diagnosis of aneurisms.⁶ Lastly, the symptoms pertaining to parts in the vicinity will also be of great help, and in pointing out to you the organs compressed by the aneurismal sac, they will indicate the extent and the seat of the latter.

Such, gentlemen, is the operative procedure, and such are the indications for electro-puncture. I told you that I intended to perform this operation on a patient in our hospital; in the next lecture I shall examine before you the conditions which this man pre-

sents, and the chances which we have of ameliorating his state.

NOTES TO CHAPTER II.

I. We take from the "Critical Review on the Treatment of Aneurisms of the Aorta," by Bacchi, the two following observations of Baccelli:

Case 1.—L. Z., aged 43 years, shoemaker, a hard drinker one year before entering the hospital at Rome began to feel pains in the right side of the thorax, located particularly in the region of the right sterno-clavicular articulation and the shoulder blade. He was easily fatigued on making the slightest exertion. On examination there was found to be want of symmetry in the infra-clavicular regions, and on the right side near the sterno-clavicular articulation was seen a roundish tumor, covered by healthy skin. This tumor was pulsatile, elastic, and resistant. On auscultation was heard a double pulsation, but no bruit. The heart sounds were normal, but the aortic sound was a little accentuated. With the plessimeter it was found that the longitudinal diameter of the tumor measured seven centimetres, the transverse, six. Nothing of importance in the other organs. Diagnosis: A pouch-like aneurism at the upper and anterior part of the ascending aorta, and outside the pericardium.

March 27th, 1873, Baccelli introduced the watch-spring into the aneurism. The patient did not feel any pain; a bladder of ice was kept constantly applied over the tumor. On the 29th the pulsations from the tumor were less intense. April 4th the tumor had somewhat subsided, the pulsations were less violent, less visible, the pains in the arm had disappeared, but a few days later the state of the patient began to get worse, and he died May 26, after having presented symptoms of coma and dyspnoea.

Baccelli attributed the death to an accident of the operation. He had not succeeded in introducing the entire spring into the aneurismal pouch, and on that account the coagulation of the blood took place too slowly. Moreover, the end of the spring had eroded its way out of the sac.

At the autopsy there was found extensive œdema all over the fronts and sides of the right thorax, and an ecchymotic spot over the region of the tumor. The sternum was much thinned out by the compression; on detaching it from the tumor, the latter gave way, and there issued a quantity of blood, partly liquid and partly coagulated. The aneurism occupied a large part of the right thoracic cavity, and presented on its anterior aspect an erosion corresponding to the point of introduction of the spiral, from whence was seen projecting the end of the spring surrounded with a large clot. On opening the sac, the spring was seen to be broken into six pieces, each of which formed the nucleus of a firm, resistant clot. The walls of the sac were covered with dense layers of fibrin, but presented no traces of inflammation; the margins of the orifice of the sac bore the marks of chronic endarteritis; the descending aorta was atheromatous; the heart was normal. There was atheroma of the cerebral arteries; no emboli were found.

The right lung was compressed, in great part hepatized, destitute of air, crowded against the vertebral column and the ribs. The left lung was congested and œdematous; the vena azygos was also compressed, as well as the right bronchus and the sympathetic trunk, which was in many places found affected with fatty degeneration. The liver was congested and the spleen reduced to a state of pulp.

Case 2.—The second case was that of a woman 46 years of age. The diagnosis was sacciform aneurism of the ascending aorta, protruding above the pericardium, and on the antero-superior and internal aspect of the great artery, in front of the mouth of the innominate, and manifesting itself externally in

the region of the sterno-clavicular articulation, below and internally to the sterno-mastoid, below and externally to the sterno-clavicular articulation, and the sterno-costal articulations of the first two ribs. April 23 there were introduced three spirals of a watch spring; total length, 1 metre 10 centimetres.

The patient did not suffer any pain, and had no fever; the tumor diminished in size the following days, and the pulsations were lessened; the harsh murmur previously heard became softer. The patient continued to grow better, till on one occasion she was examined a little too roughly by some medical students. A stethoscope was applied with so much force over the tumor that the patient uttered a cry of pain. From that time the aspect of the case was changed for the worse; there was fever, pain, augmentation of pulsations, dyspnœa, vomiting, and extreme prostration. The patient died May 3, and Baccelli attributed her death to the accident that happened during the examination.

The autopsy showed that the compression by the stethoscope had caused a separation of part of the clot from the walls of the sac. Baccelli observed the presence of a great quantity of clots between the anterior wall of the sac and a firm, fibrinous, stratified mass, which filled the sac as far as its middle; there were no traces of inflammation of the walls of the sac. Among the clots were found ten pieces of the spiral. The dilated ascending aorta was affected with chronic deforming endarteritis. The meninges of the brain were engorged with blood; there was a little effusion under the arachnoid; the substance of the brain showed punctiform congestion; but the vessels of the circle of Willis were not obstructed. (Bull. de Ther., 1878.)

[The following paper is kindly communicated to the translator by Dr. Robert Abbe of New York. It was read before the N. Y. Surgical Society, March 23, 1887, and published in the Medical News, April 9, 1887.]

ANEURISMS TREATED BY THE INTRODUCTION OF CATGUT, OR
OF WIRE, WITH ELECTRICITY.

The domain of cases upon which the surgeon may operate, owing to newly adopted principles, is enlarging year by year, and just in that proportion the number of "hopeless" cases diminishes. The most superficial observer will see a growing disposition to interfere with many varieties of infirmities for which in the past active treatment has been discouraged by all surgical authorities. One is led from time to time to review such maladies, and to ask whether advanced methods will yet allow us to touch them. As the miner has often found a fortune in the discarded ores of silver mines when worked over by a new process, so now some of the forbidden cases of twenty years ago are fairly met by justifiable new procedures.

In this spirit of inquiry I venture to open the question of the value of interference with a small class of aneurisms, the treatment of which has heretofore been considered useless. This class is that of aneurisms springing from the aorta or its greater branches, and not amenable to the ligature or relieved by medicine, diet or rest. These are so common that we all see them from time to time. They run a steady downward course, interrupted, happily in some cases, by a temporary clotting, but soon advancing again, leaping the barriers of bone and cartilage, until the thinned walls give fatal pressure-effects on veins, nerves, or the trachea, or sudden rupture ends the patient's misery.

Taking our guide from nature's attempt at repair by the deposition of firm clot, or by thickening of the sac through hypertrophic or inflammatory changes, we find the most promising method to be that of inducing clot within the sac.

Practically, accumulated experience shows that coagulation *will* take place upon certain foreign substances introduced

into the blood current. Wire is especially favorable, either silver, iron, or steel. This can be sterilized by preliminary boiling in carbolic solution. Thirteen cases of the use of wire have now been reported, to which I am able to add two more. The first attempt was made by Mr. C. H. Moore, of Middlesex Hospital, in 1864, of which I will speak later. Moore's method consists merely in the introduction of wire. Of the cases now on record, the most brilliant results were obtained last year by Loreta, of Bologna, and Morse, of San Francisco. The outcome of the others has not been curative, though seeming to look in the right direction.

Last year Mr. Richard Barwell practised a modification of Moore's method, by introducing ten feet of steel wire into an aneurismal sac and passing a current of electricity through it, sufficiently strong to obtain an electrolytic action and to induce the formation of a coagulum by quick deposit. Thus he substituted a long wire, coiled in the blood-current, for the short needle-point of so-called electro-puncture, which latter alone has in many hands been of unquestionable service in ameliorating the condition of aneurisms in the last stage.

Mr. Barwell's patient was a man with large aneurism of the aortic arch, apparently a hopeless case, and associated with serious lung trouble. A fine, insulated trocar served to allow the steel wire to pass. The positive pole was attached to this, while a negative pole of spongio-piline was spread over the back. A current of ten milliampères was passed for an hour and ten minutes. The man had no pain or inconvenience. The tumor gave no sign of immediate improvement, but in twelve hours "the man appeared much better, the tumor was more solid, and the pulsation more distant." Four days later a tumor appeared at the other side of the neck, which had been observed two years before, and then disappeared—evidently an extension of the sac in that direction. One week later he died of his pulmonary trouble. A post-mortem was obtained,

and of the clot that was formed in the aneurism he says: "The wide coils of wire are surrounded by thick, firm, colorless clot, which in many places binds the wire to the sac-walls, thus strengthening them and rendering rupture hardly possible where the wire had penetrated. In the secondary sac this had not formed." Barwell commends the method for large internal aneurisms.

Soon after the publication of Barwell's case, Dr. J. West Roosevelt, of this city, had an opportunity to try the method on a case of aggravated aortic aneurism threatening death. He has kindly offered me the case to report in this connection.

The patient was a man of twenty-five years, with a syphilitic history. In November, 1885, he began to notice a dry cough; some weeks later dyspnoea and dysphagia ensued, and pain was present in the right pectoral region and axilla, occasionally extending down the right arm, or into the back near the scapula. At that time also he noticed a pulsating tumor in front of the chest at the right of the sternum. His dyspnoea was great when he lay on the left side or back. He had been prevented from working for four months, yet he was in fair flesh. The pulsating tumor involved the four upper ribs near the sternum and gave a double bruit. He was given iodide of potash, was kept at rest, and somewhat under the influence of anodynes for two weeks with slight ease from pain, but the tumor continued to enlarge.

On the 4th of August, Dr. Roosevelt placed the man on his back, and inserted a short, insulated aspirator-needle into the tumor; when the blood trickled out, he passed about seventy-five yards of fine steel piano-wire (No. 00). The patient experienced some feeling of weakness, became pale, and had pain, from the position on the back, to which he was unaccustomed. The wire was connected with one pole of a constant battery, and a large wet reophore was placed under

the right shoulder. From four to eight cells of an ordinary galvanic battery were used, measuring about twenty-five milliampères. It gave him no pain, and was continued for a half hour. The tumor still pulsated. The patient was kept quiet another half hour and then was put to bed. He had no pain subsequently from the operation. On the following night he required morphia for insomnia.

Next day the tumor did not pulsate so strongly, and he had some pain and vertigo. On the third day the tumor was less painful, but still pulsated. His breathing was not so comfortable, and in the evening his temperature rose to 100° , but fell to normal in the morning and remained so afterward. On the fourth day dyspnœa and slight cyanosis appeared. On the seventh day he was better than before the operation, and had less pain and dyspnœa. By the tenth day the tumor was much less painful, the pulsation visibly diminished, and he could breathe easily lying on his back or left side, which he formerly could not do. During the third week he could swallow and breathe with greater ease and the tumor felt harder. At the beginning of the fourth week he began to vomit, and to complain of headache. His iodide of potassium was, therefore, stopped. On the twenty-second day a painful dark-colored spot appeared on one toe, and the man appeared badly. On the twenty third day he died. No autopsy could be obtained.

In October last, I had an opportunity to repeat this operation in the following case: A man, forty-six years of age, free from specific history, was referred to me by Dr. Naughton, for treatment of a large pulsating tumor at the root of the neck, on the right side. It had been observed as a very small swelling above the clavicle, not more than a year before, and had steadily enlarged until now it filled the supra-clavicular space, extending backward to the scapula. The greater growth of late had been back of the middle plane of the neck,

A loud bruit could be heard over its entire surface. Its pulsation lifted the shoulder at every beat. Neuralgic pain of the right shoulder and arm had been coming on for several weeks, and pressure on the brachial plexus caused paralysis of the deltoid and triceps muscles. The right arm and right half of the face remained dry, while the opposite side was covered with profuse perspiration. There was slight hoarseness. The right pupil was smaller than the left, and ptosis of this eye had developed. The axillary, brachial and radial pulses were small. A diagnosis of dissecting aneurism of the subclavian was made.

After consultation (Drs. Sand, Weir, Peters, McBurney, Bangs, Lange, and Bull) it was decided that the condition would not be checked even by ligature of the carotid, with shoulder amputation, and being left with a patient whose pain was only eased by frequent hypodermatics of morphine, while the growth of the aneurism could be seen to advance every day, I decided to resort to Barwell's method, to lengthen his life, and, perhaps, to lessen the pain. The oval cavity of the tumor was estimated to measure four by five inches.

After three weeks' observation, under iodide of potassium, I decided to use catgut before employing wire. I operated on November 19, no anæsthetic being given. With a No. 2 aspirator-needle, I pierced the front of the sac, and the blood spirted out to a distance of two or three inches. No. 1 catgut, taken fresh from juniper-oil, and drawn through a damp sublimated towel, was easily, though slowly, pushed into the sac. It was best fed by short grasps of the thumb forceps. One hundred feet of it were thus introduced, occupying an hour. The patient lost two or three ounces of blood only, and had no pain, or discomfort, whatever. There was a slight rise of temperature (to 101° F.), on the following day, the pulse remaining unchanged. The tumor was a little warmer than before. On the second day the patient continued to feel well.

The outer third of the sac had very decidedly hardened; the remainder pulsated as before. An ice-bag was ordered to be applied. The radial and brachial pulses could not be felt. The hand continued warm. On the third day his temperature rose to 102° , though he felt otherwise as well as he did before the operation. After that his temperature declined rapidly to normal. The tumor, however, grew decidedly backward and upward during the week, and lifted the scapula. On the eighth day the dissection seemed much more rapid, and the hoarseness amounted to aphonia.

On the ninth day Dr. Roosevelt very kindly assisted me, and I introduced through an insulated aspirator-needle one hundred and fifty feet of fine steel wire, sterilized by boiling in carbolic acid solution; a copper plate a foot square, covered with wet cotton, was placed over his back and was connected with the negative pole, and the positive was attached to the end of the wire. The current was measured by Dr. Roosevelt up to fifty milliampères, which was the limit of the register. This required but fifteen cells; the entire thirty-six cells of the galvanofaradic battery were subsequently applied. The patient experienced no pain or discomfort. His pulse, which had been 110, rose only ten beats during the process. The current was continued for an hour—the latter part of the time reversed, so as to bring the negative pole within. He was rather exhilarated than otherwise, and when removed to bed would not have known that any operation had been done.

The tumor still pulsated when we concluded. On the following day I could perceive an increased firmness in the walls, though the pulsation continued. Subjectively the patient felt rather better, and I had some hopes of the outcome, when, on the second evening, he suddenly had a rupture of the sac into the trachea and expired. It was impossible to obtain an autopsy.

Although it is to be regretted that these cases could not be

followed to the post-mortem table, there are yet some points of value in each that may be added to the study of the subject. It will be seen that both were utterly hopeless cases, and, while we cannot assert that life was prolonged, it was not shortened by the operation. In my own case the man was approaching his end, and it was his only hope.

The question may be asked, whether the rupture of the sac into the trachea was hastened by the pressure of the wire inside. I judge not, for the tracheal pressure that preceded the rupture had been progressively getting worse, as evidenced by the hoarseness increasing for a month—showing that it was making its way toward the trachea. I find three other cases of rupture following active treatment. One of Churton's last year, in which he had used electro-puncture without wire, and in twenty minutes fatal hemorrhage from the trachea ensued; the other was Domville's case of aortic aneurism, in which he put fourteen inches of iron wire into a sac, and when four weeks later the man died of sudden rupture into the pleura, it was found that no wire was near the perforation. The same occurred in Dr. Ransohoff's case, reported at the last meeting of the American Medical Association; over ten feet of silver wire were introduced into the sac, in two sittings, three weeks apart. Death suddenly occurred one week after the last, from rupture into the pleura, but the autopsy showed that there was no wire near the place of rupture. (*The Medical News*, May 29, 1886, page 597.)

Whether the duration of life was longer or shorter owing to the treatment by wire insertion, is pure speculation. My own impression is, from studying all the cases, that without exception every one was in a desperate state before operation. Some even threatened dissolution. My own patients lived thirty-six hours only before rupture occurred. Most of them lived several weeks, and Loreta's, ninety-two days, having apparently been restored to health, while Morse's still survives.

In one case reported by Mr. W. Cayley, the large aneurism at the root of the neck became solid and the patient lived eighty-six days after some forty feet of steel wire were introduced. The thoracic portion of the aneurism extended, and Mr. Gould subsequently put in thirty-five feet more, to solidify if possible the portion that was causing serious dyspnœa. No disturbance followed nor was he relieved.

As regards the chances of emboli from the wire giving trouble, I find but two of the fifteen cases in which wire was introduced, that caused such an accident. Mr. Moore's case, the first on record, showed at the post-mortem suppurating foci in the kidneys, with death on the fifth day. As the case occurred in 1864, it is quite as probable these were septic as that they were embolic. No case that has since been done has shown septic infection, due to the care now exercised in sterilizing the wire.

In a note in the *British Medical Journal* of May, 1885, Dr. Maclean, who witnessed Mr. Moore's operation twenty-three years ago, and who saw the organs and aneurism after the autopsy, says that the immediate cause of death was inflammation of the sac and the pericardium, and he also recalls the innumerable clots, in the fresh preparation, of varying consistence, hanging from the wires, ready to drop into the blood, and emboli exactly like them were found in the arteries of the organs dissected to show them. In Dr. Roosevelt's case a dark-colored, painful spot appeared on one toe on the twenty-sixth day. The absence of other reported accidents by emboli, shows that it is no more to be feared from wires than from the untreated walls of an aneurism.

Having shown that nature will tolerate considerable quantities of wire for periods of eighty-six and ninety-two days, and even indefinitely in favorable cases, as in Dr. Morse's, and that it has never been known to induce suppuration when aseptic, it is now of importance to see how much solidification

is really brought about by the foreign substance. Of the sixteen cases of wire-insertion, eight were followed to an autopsy. Baccelli's third case, in which seven watch-springs, each about twenty inches long, were inserted, was the only one which failed to show coagulation. The patient lived only two days. His second case, in which three springs were introduced, lived ten days, and excellent clots were found around the metal. His first case, in which only one spring was used, lived two months, was improved, and presumably the wire was imbedded. In Domville's case fourteen inches of iron wire were found imbedded in firm clot, two weeks after its introduction into an aortic aneurism, the patient dying of ruptured sac. Dr. Ransohoff reported last year a case of large aneurism at the root of the neck, into which he put at two sittings ninety-eight and ninety-six inches of silver wire. The case was hopeless from the first; however, the patient survived over four weeks. Autopsy showed the "coils of wire imbedded in recent and old clot." In Mr. Cayley's case of large sacculated aneurism of the aortic arch, the patient survived the introduction of seventy-five feet of steel wire eighty-six days, and the "entire upper portion of the sac was filled with clot, in which the wire was imbedded." In Barwell's case (already quoted) the electricity and wire combined had caused the latter to become "surrounded by thick, firm, colorless clot, which in many places bound the wire to the sac-walls, thus strengthening them." In Prof. Loreta's famous case (reported last summer) the post-mortem revelations were very gratifying. The patient was a sailor, who had an aneurism of the abdominal aorta, the size of a small foetal head. Laparotomy showed it to be matted to the viscera, stomach, etc., from which it was separated. Six and a half feet of silvered copper-wire were introduced through a fine canula, the point of perforation was touched with pure carbolic acid, and the wound was closed. He made an excellent recovery. Twenty days later the pulsation had ceased,

and by the seventieth day he resumed his work. On the ninety-second day the aorta ruptured at the point at which the sac sprang from it. Autopsy showed that the latter had shrunk to the size of a walnut, and was completely filled with coagula of organized fibrin. The wire was found unaltered, and rolled into a globular mass within the sac.

Dr. Morse's patient, in San Francisco, a man of thirty-two years, received a blow from a coal bucket which resulted in an aneurism of the abdominal aorta, which grew for eight months, accompanied with much suffering. Loreta's operation was done, and four and a half feet of silvered copper wire introduced into the sac through the laparotomy wound. The tumor was the size of two fists.

The patient's subsequent temperature remained below 101°.

On the ninth day the left femoral artery became plugged, whether from embolism or endarteritis, cannot be said. Pulsation returned in it, however, in the fourth week. The tumor shrank to a small nodule, and so remained without bruit. The patient left the hospital less than eight weeks after the operation—apparently cured.

Dr. Lange reported a case to our Society quite recently, in which he obtained an autopsy. He had inserted thirty feet of wire into an abdominal aneurism. The patient survived twelve days. The specimen showed the wire imbedded, to a large extent, in firm clots against the wall, but free in some places in the current. It is reasonable to believe that it would always be buried in laminated clot, if left for a while.

As bearing upon this point, I would note that Schrötter, of Vienna, two years ago inserted twenty inches of Florence-silk into a large aneurism, and four days afterward thirty inches more. The patient died in the third week, of pulmonary œdema, and the autopsy showed the silk in coils entirely enclosed in laminated clot. In Bryant's case of popliteal aneu-

rism, the horse-hair was enveloped (to use his words) in "huge laminated clots." The inflammation of the sac-wall probably plays no small part in aiding solidification. I feel convinced that it is desirable to provoke some inflammation. In my patient there was a decided increase of local temperature in the outer part of the sac, with slight oedema of the subcutaneous tissue, and hardening of the sac. This followed on the second day, after one hundred feet of catgut had been introduced. The continuous application of an ice-bag entirely controlled the inflammatory action. In Schrötter's case of silk introduction, it is reported that "intense oedema appeared in the vicinity of the sac from its inflammation," the virtue of which was apparent, in the imbedding of the silk, as was found three weeks later at autopsy.

Finally, I would review the part that electricity may play in the combined treatment. We have but three cases in which the sac was subjected to electrolytic action through an extensive wire coil within it. Barwell used a current of ten milliamperes, Dr. Roosevelt about twenty-five, and I one hundred. The patients experienced no pain or discomfort whatever. The current was passed for a period of from half an hour to an hour and ten minutes. In my case the current was reversed during the latter half hour, so as to bring the negative pole within. No change in the patient's condition could be perceived, and no gas could be discovered in the sac, as in some cases of electro-puncture, where it became tympanitic for a short time, without harm.

The promising statements of Ciniselli and others about the value of electrolysis in aneurisms have seemed to many delusive. The small amount of coagulation that takes place around a fine needle is, perhaps, of less value than the irritation of the sac. Therefore, it seems reasonable to my mind that if we tangle a mass of fine wire so that it will reach every part of the sac, and then cause a deposition of clot on it by

electrolysis, we do more justice to the method. Ciniselli claims that no cure of aneurisms takes place after electrolysis without inflammation of the sac.

Occasionally a case succeeds, as one reported by Dr. Simpson, of Manchester, in 1881; an aortic aneurism that had eroded the rib and threatened to rupture, continued well five years after repeated electro-puncture.

As regards the strength of the current to be applied, experience only will say. De Watteville thinks that twenty or thirty milliampères for each needle are sufficient, others five or ten. But, when a large wire surface transmits the current, it is probable that fifty or one hundred are not too strong.

CONCLUSIONS.

It is evident that we need many accurate scientific observations before we can speak definitely of the value of Barwell's method. One may say that Moore's treatment, by simply placing wire in the sac, has not yet been tried in any case that was not already hopeless and in the last days of life. The same may be said of Barwell's; yet the evidence warrants a continuance of its trial. It is not a coincidence that cases show a decided amelioration of symptoms.

It has been proved that there is a deposition of clot; sometimes so abundant as to cure, as in the cases of Loreta and Morse. The fine wire is so yielding that it may be compressed by the aneurismal contraction into a small fraction of its bulk, without exerting much expansile reaction against the wall; and it is probable that an hour's electrolysis so far weakens it, as well as roughens its surface, that it is quite prepared for the deposition of the clot and the shrinkage of the sac.

The operation is not in itself perilous; no deaths have occurred from its performance. The subsequent much-desired

inflammation of the sac was easily kept under control by ice-bags in every case.

The principle does not seem faulty, and its application should not be abandoned or condemned, until much more extended trial has been given to it.

CASES.—*Moore*: Med.-Chir. Trans., xlvii, p. 129. *Domville*: Stimson, Ref. Hand-book. *Bacelli*: Bul. gén. de Thérapie, 1878, vol. xcv, p. 262. *Bacelli*: Brit. Med. Jour., 1885, vol. i, p. 1256. *Murray*: Brit. Med. Jour., 1872, vol. i, p. 596. *Rubio*: Brit. Med. Jour., 1886, vol. i, p. 395. *Loreta*: Mem. Royal Acad. of Bologna, vol. vi; Brit. Med. Jour., 1885, vol. i, pp. 668, 955. *Ransohoff*: The Medical News, May 29, 1886, p. 597. *Barwell*: Brit. Med. Jour., 1886, vol. ii, p. 675. *Cayley*: Brit. Med. Jour., 1886, vol. ii, p. 395. *Lange*: The Medical News, November 20, 1886, p. 582. *Morse*: The Medical News, March 5, 1887, p. 264. *Roosevelt*: The Medical News, April 9, 1887, p. 398. *Abbe*: The Medical News, April 9, 1887, p. 398.

2. The action of electricity in promoting coagulation of the blood has been studied by many physiologists. Brugnatelli and Brandes, Prevost and Dumas, Moson, Scudamore, Ev. Home and Davy, Schuebler, Medici, Gandolphi and Aldani have noted the effects of electricity, and seen coagulation effected at the positive pole. But it was Pravaz and Guérard, of Paris, who first had the idea of applying galvanism to the treatment of aneurisms (1831). At this time Phillips, an English surgeon, also treated aneurismal tumors by galvanopuncture and acupuncture. In 1837 appeared in Paris the thesis of Clavel, and in 1838 that of Girard, of Lyons, on the same subject, giving results down to date. In 1848 an unsuccessful attempt at galvanopuncture was made in England (subclavian aneurism). Another attempt, also without success, was made by O'Shaughnessy, of Calcutta, for an aneurism in the neck, (aneurism of the aorta). Bellingham, in 1846, wished

to conjoin galvanism with indirect pressure, and passed electrical discharges into the sac, but without success.

In 1845 Petrequin, of Lyons, published three cases of aneurism treated by galvano-puncture; he had treated successfully an aneurism of the temporal artery. The year following (in 1846) Ciniselli, of Cremona, applied this method to a popliteal aneurism; it was not till the day after the operation that coagulation took place; the tumor diminished little by little. This patient got well. Debout and Vial, of St. Stephens, treated without success, in two instances, traumatic aneurism of the neck. Hamilton, of Richmond, employed galvano-puncture for a carotid aneurism; at first the operation seemed likely to succeed, but several days after the tumor increased in size, and the pulsations, which had ceased, returned. At the autopsy of the patient, who died a short time after, the sac was found filled with solid fibrinous clots. Bossé treated an aneurism of the aorta by introducing six needles, six centimetres in length; only one was connected with the negative pole, the others were alternately put in communication with the zinc pole, in order to obtain a greater number of clots. He affirms, in fact, that the clots formed around the positive needles dissolve when the needles are put in communication with the negative pole.

Since this time, many attempts have been made and numerous publications have appeared on this subject, notably the memoir of Ciniselli, in 1847; and the Report of the Commission of Turin in 1851, has shown the results which may now be expected from the application of electricity to the treatment of aneurisms.*

* Ev. Home, Hints on the Subject of Animal Secretions (Philosoph. Transactions, 1809). Schuebler, Dissertatio de experimentis quædam, influxum electricitatis in sanguinem et respirationem spectantia. Tubingen, 1810.—Velpeau, Piqure ou acupuncture des artères dans le traitement des anévrysmes (Gaz. méd., 1831; Médecine opérat., 1839).—Benj. Philipps, Ex-

3. Longet in his treatise of Physiology gives the following results obtained by several experimenters relative to the quantities of gases dissolved and in feeble combination in the blood. The volumes of gases extracted were subjected to zero temperature, and the pressure of 76 centimetres of mercury. The experiments of Fernet and of Lothar Meyer were made after the same process, i. e. by boiling in a vacuum the arterial blood of a dog diluted with from ten to twenty times its volume of boiled water.

According to Fernet, the mean in round figures is as follows: 232 c. c. of gases dissolved in 1000 c. c. of blood, i. e. 174 c. c. of oxygen, 4 c. c. of nitrogen, and 54 c. c. of CO₂. The portion of combined carbonic acid, obtained with tartaric acid was found to give an average of 185 c. c., making the total amount of gases dissolved and combined in the blood 420 c. c.

Lothar Meyer has found an average of 249 c. c. of gases periments showing that Arteries may be Obliterated without Ligature, London, 1832.—Leroy (d'Etiolles), Sur les Moyens de suspendre le cours du sang dans les artères (Gaz. Méd., 1835, t. III).—Clavel, De l'électropuncture (Thèse de Paris, 1837).—Liston, The Lancet, 1838.—Pétrequin, Comptes rendus de l'Acad. des sciences, 1845, t. XXXI, p. 55; Gaz. méd. de Montpellier, 1846; Bull. de Thérap., t. XXXI, p. 294; Bull. de l'Acad. de médecine, 1849; Bull. de Thérap., t. XXXII, p. 123).—Ciniselli, Gaz. med. italiana, Milano, 1846.—J. A. Gérard, Essai physiol. et thérap. sur la coagulation du sang (Thèse de Lyon, 1838).—Reynaud, de Toulouse, Essai physiol. et thérap. sur la coagul. du sang (Gaz. méd. de Paris, 1874).—Rognetta, Ann. de thérap. ds Paris, 1846-47, t. IV.—Strambio (G.), Sperimenti di galvano agopuntura instituti sulle arterie e sulle vene. Milan, 1847.—C. Roux, Thèse de Paris, 1848.—Debout, Bull. de Thérap., 1847, t. XXXII.—Bossé, Gaz. méd., 1850.—A. Meige, De l'applic. de la galvanopuncture au trait. des anévrysmes (Thèse de Paris, 1851).—Lapanne, Trait. des anévrysmes par l'électropuncture (Thèse de Paris, 1851).—Boinet, Rapport sur le trait. des anév. par la galvanopuncture, 1851 (Mém. Soc. de chirurg., 1853).—G. Strambio, Bull. de la Soc. de chirurg., 1853).—G. Strambio, Bull. de la Soc. de chirurgie, 1852-53, t. III.—Werner-Stellin, De la galvanopuncture dans le trait. des anévrys. et des varices (Union médicale, 1853).—Broca et Regnault, in Broca, Des anévrysmes et de leur traitement, 1856.

dissolved in 1000 c. c. of arterial blood, i. e. 150 c. c. of O, 42 of N., and 57 of CO₂. As for the portion of carbonic acid combined and obtained with tartaric acid, its average was 160 c. c.; giving a total of 409 c. c.

According to the experiments of Setschenow (gases obtained by the aid of the pneumatic machine, and ebullition in a vacuum at 40°, without the addition of boiled water), the average in round figures is 608 c. c. of gases dissolved in 1000 grammes of arterial blood; 205 c. c. of O, 15 cc of N, and 387 of dissolved CO₂. Of combined CO₂ there was obtained 33 c. c.

Schöffner has made some experiments having for their object to estimate the relative quantities of gas in arterial and venous blood (zero temperature, pressure 76 c. c.) with the following results:

Arterial blood, CO₂ in solution, 374 c. c., combined 13 c. c.; oxygen, 203 c. c.; nitrogen, 16 cc.

Venous blood: CO₂, in solution, 415 c. c.; combined, 34 c. c.; oxygen, 135 c. c.; nitrogen, 15 c. c.

Venous blood then contains more carbonic acid than arterial blood, and arterial blood more oxygen than venous blood.

4. Gaiffe's battery is composed: 1. Of pairs of cells from 24 to 60, chemical elements being MNO₂ and ZnCl; 2. a double collector surmounting the compartment for the cells; 3. a galvanometer; 4. a rheostat; 5. the electrica conductors and accessories. The collector is an apparatus by which one is enabled to put in action as many pairs of cells as may be desired. The double collector, invented by Gaiffe, allows the utilization of all or any number of cell couples, and enables one to reverse the current without sudden shock, also to verify the battery without taking it apart, and to determine what couples are at fault when by some accident the battery fails to work properly.

5. The voltameter is composed of a glass jar filled with acidulated water; there are outlets for water from an inner tube; through the bottom of this tube two platinum electrodes pass and enter the liquid. The action of the current decomposes the water, and gases bubble up, which are collected at the top of the inner tube.

The voltameter, which indicates the rapidity of the chemical action of the current, would be of greater practical use did it not require a long experience to understand and manage it properly, and if it were not necessary to add to the indications given corrections of temperature and atmospheric pressure.

Till recently, batteries have been furnished with collectors, for purposes of graduation, more or less ingeniously constructed, by the aid of which it was possible to vary the intensity and tension of the current, but only simultaneously and proportionately.

To enable electricians to vary the intensity of the current, Gaiffe has added to his dial collector a rheostat of 40,000 units, which is placed, not in the path of the derived current, as is the case with German batteries, but as a resisting medium directly in the circuit itself.

The tension being proportional to the number of pairs of elements, and the active strength of the current being the product of the tension of the current divided by the resistance, it is easily seen that if you vary by the aid of the rheostat the resistance of the circuit without changing the number of couples, you will modify the active strength of the current or the electro motive forces. It is therefore plain that when you wish to vary the strength you must use a greater or less number of pairs of cells, and regulate the intensity of the current by the aid of the rheostat, by which the resistance is modified till the galvanometer indicates the proportional tension.

To obtain a rheostat which fulfills the conditions of resistance, of weight, and of volume, needful for medical purposes, Gaiffe has replaced the wire bobbins ordinarily employed,

which are expensive, heavy, and occupy much room, by little rods of a semi-conducting substance, which is not materially affected by the passage of the current or by the temperature.

The galvanometer of Gaiffe's battery, instead of carrying an index divided into the degrees of the circle, an index which has a different value with different instruments, and is of no use for comparative experiments, is divided into fractions of the unit of the British Association. It gives at a glance the strength of the current, and enables you to determine as accurately the chemical action which you are obtaining in the cells of your battery, as you can determine by the aid of scales the amount of the various substances which enter into a medicinal prescription.

A current which deviates the needle of the galvanometer by one degree, gives by a comparison of electrolysis of water about one cubic millimetre of mixed gases per minute, at zero temperature, and under the pressure of 760 millimetres.

6. Franck, in the *Journal d'Anatomie et de Physiologie*, April, 1878, gives the following summary of facts respecting the comparative value of signs derived from the examination of the arterial pulse in cases of aneurism of the innominate, of the aorta, and of the subclavian:

1. The diminution of the amplitude of the right radial pulse generally constitutes a good sign of aneurism of the innominate, but this sign may be wanting, and may be replaced by an exaggerated amplitude of the pulse. It has not then the value which is ordinarily attributed to it.

2. The excessive retardation of the right radial pulse is, on the contrary, a constant phenomenon which is not susceptible, like the foregoing, of being notably modified by influences other than such as belong to the aneurism.

3. The inequality of amplitude of the two radial pulses is also met in aneurism of the aorta; the amplitude is exaggerated, sometimes on the right side, sometimes on the left,

and this appears to depend principally on the position of the aneurism in its relation to the innominata and left subclavian. It results from this, that in aneurism of the innominata, as in aneurism of the arch, an examination of the radial pulse, made only from the point of view of amplitude, cannot furnish sufficiently precise diagnostic signs; on the other hand, in taking account of the retardation of the pulse, you will find this retardation exaggerated *on both sides* in aneurism of the aorta; *on the right side only* in aneurism of the innominata.

4. The existence of an excessive retardation of the right radial pulse enables us to exclude in the diagnosis aneurism of the aorta, but it still permits hesitation between aneurism of the innominata and aneurism of the thoracic portion of the right subclavian.

To establish this differential diagnosis, so important from the point of view of surgical intervention, you must give due weight to the following considerations: If the aneurism is seated on the brachio-cephalic trunk, which is common to the carotid and subclavian, the exaggerated retardation of the pulse is observed *in each of the two arteries*, at equal distance from the heart. If the aneurism occupy the deep portion of the subclavian, the exaggerated retardation of the pulse will be constant only in the course of the arteries of the right arm; the carotid pulse will preserve its normal relation to the onset of the cardiac systole.

CHAPTER III.

TREATMENT OF ANEURISMS OF THE AORTA BY ELECTROLYSIS.

SUMMARY.—Observations of Patients Treated by Electrolysis
—Results Given by this Method—Improvements in the
Art of Electrolysis.

GENTLEMEN:—In the last lecture I described the rules to be followed in the application of electrolysis to the treatment of aneurisms of the aorta, and I told you at the close of the lecture that I intended performing the operation on a patient then in our hospital wards. To-day I purpose to give you a statement of the case, and the results of the operation.

The patient to whom allusion has just been made occupied No. 9 of Ward St. Lazare, and was a man 36 years of age, who had lately come from Montivideo, where he had been living the past ten years. Two years ago this man was attacked with a pain in the right side of the chest, to which he could assign no cause; then he observed at this point a notable bulging of the chest walls; at the same time his voice became weak and husky, and he had difficulty in swallowing. From these symptoms, the physicians of Montivideo diagnosticated aneurism of the aorta, and on the 12th of January, 1877, this patient left his home for medical treatment in Bordeaux, where he was for a time under the care of Dr. Burguet, who recognized the exactness of the diagnosis made by the

physicians of Montivideo, and treated him by ice and iodide of potassium. Under the influence of this treatment there was a slight improvement; but there supervened one of those unlucky complications which I mentioned in a previous lecture, when speaking of ice applications to aneurisms, namely, a bronchitis so intense that the physician was obliged to cease the refrigerant treatment. The patient then left Bordeaux and came to Paris, and entered our hospital March 17th, 1877.

We detected a well-marked aneurismal tumor in the right side of the chest, in the region of the second, third, and fourth intercostal spaces of that side; at this point the sac bulged outwardly, and expansive pulsations were perceived which were coincident with those of the heart. The three following tracings, taken over the tumor with both the cardiograph and sphygmograph, show you the extent of these pulsations:



FIG. 1.
TRACINGS TAKEN OVER THE TUMOR WITH SPHYGMOGRAPH IN
FOURTH INTERCOSTAL SPACE.



FIG. 2.

TRACINGS TAKEN OVER THE TUMOR WITH CARDIOGRAPH IN
THIRD INTERCOSTAL SPACE.



FIG. 3.

TRACINGS TAKEN OVER THE TUMOR WITH CARDIOGRAPH IN
FOURTH INTERCOSTAL SPACE.

Under percussion, this tumor presented a dullness which was continuous with that of the liver; on auscultation, we perceived a double murmur, having its maximum of intensity one centimeter from the right border of the sternum. Over the heart and aorta a well-marked diastolic murmur indicated the existence of aortic insufficiency, and this fact was confirmed by the tracings of the pulse, which was that of unfilled arteries (Corrigan pulse).

In the foregoing lecture, I endeavored to impress you with a sense of the necessity of exact diagnosis before proceeding to the application of electrolysis,

therefore in the present case, although I had no doubt about the correctness of the view which I, as well as others of my colleagues, had entertained, I had recourse to the large experience and remarkable insight of my confrère and friend, Constantin Paul, who is distinguished for his rare precision in matters pertaining to the technics of diseases of the heart, to aid me in mapping out the limits of the aneurismal sac.

By the help of the double stethoscope, and the sphygmometer with liquid column which enables you to perceive the alternacy of the pulsations of the tumor and those of the heart, by the help also of percussion made with the utmost care, we determined the fact that there existed in our patient an aneurismal tumor of the ascending aorta, taking its start, in all probability, from the extra pericardial portion. The pyriform sac constituting the aneurism was found to have its apex in the second intercostal space, while its base was situated over the convex surface of the liver, which it slightly depressed. This aneurism occupied the right portion of the aorta, and extended into the third, fourth and fifth intercostal spaces. It was deemed almost certain that it communicated with the aorta by an orifice near the sigmoid valves, which we located in the third intercostal space, one centimeter from the sternum. The figure which I here place before you gives you the general shape, dimensions and situation of this aneurism. In this figure you see the letters A, D, B, C; the letter C indicates the point

where we found the apex beat of the heart, in the sixth intercostal space outside of a vertical line let fall from the nipple; the letters A, D, B, indicate the points where the electropuncture-needles were inserted.



FIG. 4.

The following report of the above mentioned case by Paul Boncourt, interne, will be read with interest:

ANEURISM OF THE ASCENDING PORTION OF THE AORTA—AORTIC INSUFFICIENCY.

M. G., æt. 36; by occupation a cook; entered the service of Dujardin-Beaumetz, Ward St. Lazare, No. 9, March 17th, 1887.

Previous History.—This man has till lately enjoyed good health; he has never had rheumatism or syphilis, has never been intemperate. His mother is still in good health; his father died of apoplexy.

At the age of fourteen he had all the symptoms of parenchymatous nephritis; the urine was scanty; there was general cedema; and for six months he kept his bed.

Four years ago, he fell heavily, striking the right side of the chest in the mammary region against a hard body. There was no ecchymosis, and the pain disappeared after several days. Two years ago, without appreciable cause, there came a severe pain in the right thorax shooting down the right arm; this pain was accompanied with violent palpitations, which increased under the influence of emotions and exercise. He was obliged to leave off work, and when he lay on his left side, he experienced a most intense dyspnœa. A year ago he observed a bulging of the chest wall in the region of the fourth and fifth ribs of the right side; his voice became indistinct; he had difficulty in swallowing; and the thoracic angina augmented in intensity.

The physicians in Montevideo, where he was living, diagnosed aneurism of the aorta. He left Montevideo, went to Bordeaux, where he was treated by Dr. Burguet, as before stated, afterward came to Paris and entered St. Antoine hospital.

The condition at that time was as follows: M. G. was a man of middling height, with full beard, and manifesting the pallor of an aortic affection; respiration was frequent, precipitate, and the least effort would increase the dyspnœa. The thorax heaved under the arterial pulsations, and one could not help noticing, at first sight, the existence of a marked bulging on the right of the sternum in the region of the third, fourth and fifth ribs, as far as the mammary region; over the whole extent of this bulged region heaving pulsations were visible to the naked eye—these were especially noticeable in the third intercostal space.

On applying the hand to the tumor you felt it lifted up by powerful and rhythmical pulsations. Percussion gave a dull

sound all over the tumor, a sound which was lost inferiorly in that of the liver. Auscultation presented a double murmur, which was much more marked with the second sound of the heart than with the first; the maximum of intensity of this bruit was over the third intercostal space, one centimeter from the right border of the sternum. Pressure was painful, especially over the fourth intercostal space.

The apex beat was found in the sixth intercostal space, as before stated. The volume of the heart was augmented, and there was a loud basal diastolic murmur propagated along the aorta. The pulse was bounding and compressible (Corrigan pulse).

There was nothing especially noteworthy with regard to other organs and functions; the appetite and digestion were fairly good; there was no œdema of the extremities.

The aneurismal tumor, apart from the dyspnoea it provoked, and the painful pulsations, determined symptoms of propinquity which it is important to note. The substernal pain was prolonged into the arms, and particularly into the right arm; the hoarseness of the voice and the dysphagia were intermittent and appeared at indeterminate periods.

All these symptoms incapacitated the patient for any effort; he was scarcely able to sit up or walk about, and he remained most of the time recumbent in his bed.

In view of the diagnosis, we asked ourselves if this was a suitable case for electro-puncture. You remember the indications and contra-indications which I gave you in the foregoing chapter. Did our man present the favorable conditions for the operation? He was young, and his general health was excellent, and, moreover, he was very anxious for the operation, and it seemed that this was as promising a case for electrolysis as could present itself.

The aneurism was sacciform, appended to the aorta, whose dimensions did not appear to be sensibly augmented; though forming a large pouch-like projection externally, it had not much worn away the cartilages and ribs; the arteries were healthy; one condition, and one only, was unpropitious—the existence of the aortic insufficiency—and one could easily foresee that whatever might be the advantages obtained by electro-puncture, there would always remain on the part of the sigmoid valves a lesion which we would be powerless to treat. So, weighing the considerations for and against, in view of the rapid progress of the tumor and the incessant pain experienced by the patient, a pain which prevented him from sleeping or getting into an easy position in bed, in view also of the violent pulsations of the tumor, and its seat, we decided June 14th to perform electrolysis.

You remember the operation and how it was performed. I followed the rules laid down in the last lecture, plunging into the tumor three electro-puncture needles covered at their upper part with protective coating. These needles were introduced, one in the third intercostal space of the right side, three centimeters from the border of the sternum; the two others in the same intercostal space, the one three centimeters from the border of the sternum, the other one centimeter further off. We passed the current of a Gaiffe battery through these needles, employing only the positive current, the negative pole, represented by

a metallic plate covered with moist chamois skin, was placed over the right side of the chest.

The introduction of the needles was painful, and during the passage of the current the patient experienced a keen pain at the point of the punctures. For five minutes the positive pole was applied to each needle, and this was repeated again, so that the current was passed ten minutes through each needle; then the needles were withdrawn.

I confess that this latter part of the operation caused me some nervous trepidation, for I feared bleeding from the punctures; there was, however, no oozing of blood, and nothing but the fine punctiform marks were visible. Ice was applied to the tumor, and the next day our patient experienced a real relief; the pulsations were less strong, and the pain was mitigated, and he could remain in a recumbent posture without the distress which he had before suffered. The following days he continued to improve; we felt less plainly the pulsations of the tumor, and everything indicated the formation of a clot in the sac.

We then, in accordance with the directions of Ciniselli, repeated the operation on the 11th of July, nearly a month after the first operation. This time we plunged the three needles into the fourth intercostal space; the first, one centimeter from the sternum, and the other two, one centimeter apart. The positive current, as before, was passed alternately through

each needle five minutes at a time and once repeated; the negative pole was placed over the thorax.

The patient bore the operation well, and the days following we again found a still more pronounced diminution in the pulsations. But already, coincidentally with this last operation, we noticed certain signs which showed that the heart, which hitherto had been competent to perform its task, was beginning no longer to compensate the mechanical troubles caused by the aortic insufficiency. The liver was augmented in size, and there was a slight sub-icteric state of the conjunctiva, and œdema about the ankles. These symptoms grew rapidly worse, and all the untoward events characterizing insufficiency of the cardiac muscle presented themselves.

On the part of the tumor, the amelioration continued, and despite the gradual asystolia which supervened, we never remarked any increase in the pulsations of the aneurism. The cardiac cachexia became more and more marked, and notwithstanding the administration of heart tonics and an energetic treatment, the patient succumbed on the 22nd August.*

* The results of the autopsy were as follows : Oedema of the lower extremities, effusion of serum in the left thoracic and in the abdominal cavities. Hypertrophy and congestion of the liver and kidneys. Right lung adherent to the chest wall and congested. Hypertrophy of the heart, with dilatation of its orifices; insufficiency of the aortic valves. At the point where the aorta leaves the pericardium, and connected with the ascending portion of the aorta, a large aneurismal

The autopsy, as you will infer, presented the greatest interest, and I am glad to be able by means of special drawings, and a dried specimen carefully prepared by Dr. Anger, to give you a good idea of this aneurismal sac. When you compare this representation with the outline of the tumor mapped out by Constantin Paul during the life of the patient, you see that there is perfect agreement between the results of the autopsy and the diagnosis previously made, the aneurism having been found to have the exact limits assigned to it before death. In fact, no diagnosis could have been more accurate; and I am particular in calling your attention to this point, in order to show you how perfectly we are able, by our modern means of investigation, to determine the

sac, occupying the right side of the thorax, in the third, fourth and fifth intercostal spaces. This tumor was pyriform, its base resting in the diaphragm; antero-posterior dia, 0.075 centimetres; transverse dia at base, 0.105 centimeters; transverse dia at apex 0.075; height 0.100 centimeters. This pouch, opened from behind, was found to communicate by a circular and regular orifice with the aorta; this orifice was just above the sigmoid valves. Posteriorly this tumor had a covering of its own, anteriorly its only covering was the pleura and thoracic parietes. Liquid blood filled the sac except in front, where there was a firm clot of the thickness of one centimeter adherent to the anterior part of the thorax, and thus protecting the intercostal spaces and cartilages, which had begun to suffer notable erosion. The right lung was attached to the sac by fibrinous adhesions and thus made a second protective investment.

limits and the general configuration of these pulsating tumors.

But this confirmation of our diagnosis, which showed that we had to do with a pyriform aneurismal sac whose mouth corresponded to the third intercostal space near the orifice of the aorta, and had given rise to an insufficiency of the latter (as is the rule); which also revealed dilatation of the heart and fatty degeneration, was not the only or the principal information which we sought from the autopsy; we desired especially to know what had been the effect of electrolysis within the sac. We found, then, that this tumor, which had no other covering anteriorly than the thoracic wall itself, contained a firm clot one centimeter in thickness, adherent to the anterior part of the thorax, and protecting the intercostal spaces and cartilages, which latter had commenced to undergo erosion.

These results deserve to be well considered, and notwithstanding the death of the patient, and the relative want of success of the method, it has seemed to me that the practicability of the operation was demonstrated, and that electrolysis ought to take a foremost place in the treatment of aneurisms of the aorta. The clot, formed as just described, and which we found protecting the anterior wall of the chest, was the cause of the amelioration observed during life, and was a proof of the possibility of thus protecting the adjoining parts from the incessant shock of the blood,

and arresting the aneurismal sac in its development. We were justified in affirming that in a sac less voluminous it would be possible to obtain, by this means, a coagulation in the aneurism which would be complete and lasting.

I well know that, even in admitting the transformation of a liquid into a solid sac, you have not absolutely cured the patient, and that this tumor, even if solid, being appended to the aorta, must, in a certain measure, modify the hydraulic conditions of that vessel; but the result obtained is nevertheless considerable, and might enable an individual to live a long time by lessening the chances of rupture of the aneurism, a rupture which would necessarily be fatal.

It seems to me worth the while to compare the result obtained in this instance with those obtained by my predecessors in this operation, and I cannot do better than give you Petit's statistics of galvano-puncture, taken from his article in the "Dictionnaire Encyclopédique."

These statistics, the most complete that have been made thus far, pertain to 114 cases, giving the following results by electrolysis: 69 patients were ameliorated, 38 died without any notable improvement, and in 7 the results were doubtful. When we examine attentively the 69 cases said to have been benefited, we find that 39 lived less than a year after the operation, 11 from 1 to 2 years, and 15 from 2 to 5 years.

On comparing these statistics with those furnished by Ciniselli, we find that in the case of the latter:—of 38 electro-puncture operations, there was temporary cure in 11 for the periods of, respectively, 48, 27, 23, 21, 17, 16, 7, 7, 6, 4, 1 months; in seven cases there was an improvement during 28, 16, 12, 8, 6, 3, 3 months; lastly in 11 cases no results whatever followed the operation.

These facts go to show that if physicians have not already attained the absolute cure of aneurism by electro-puncture, they have nevertheless, by this means, prolonged the lives of patients for months and even years. *

It remains for me now to speak to you about other instances of the application of electrolysis since this first trial of mine, and the modifications and improvements which have been introduced into the method.

Since the publication of the case related above, several of my colleagues have undertaken the opera-

* One of Petit's patients lived five years after the operation, another, four years, and another, one year. His statistics showed that the advantage derived from galvano-puncture is much greater when this operation is performed before the development of an external tumor, 73 per cent. of such cases having been markedly benefited by electrolysis. Of those on whom the electro-puncture operation was performed after the formation of an external tumor, only 34 per cent. were benefited. (Petit, *Art. Galvano-puncture* in *Loc. cit.*)

tion according to the rules laid down by me; Proust, of the Lariboisiere hospital, taking the lead. His first case was that of aneurism of the descending aorta, causing paraplegia; here repeated applications of electrolysis brought about for a time not only a diminution in the pulsations, but also a notable amelioration in the paraplegia. The patient, however, succumbed several months after from rupture of the sac into the pleura; the autopsy disclosed the presence of a hard, voluminous, resisting clot, filling the aneurismal pouch, which was situated, as had been accurately determined during life, below the left subclavian and carotid arteries at the point where the aorta makes its bend downwards. The aneurismal tumor had worn away the ribs and destroyed the vertebral column in a certain extent, and was making pressure directly on the cord and its membranes.

Proust's second case was an aneurism of the ascending aorta constituting a voluminous tumor in the right side of the chest, a tumor similar to that of my own patient, but not accompanied with aortic insufficiency. Several séances were had, and very great improvement followed the operation; the patient who could not sleep, or obtain any rest on account of the incessant pain, was so far benefited as to be able to leave the hospital and return to the province.

Prof. Ball in his hospital service has also operated on an aneurism of the aorta which was situated upon the ascending portion, and caused compression

of the superior vena cava and consequent varicose distention, not only of all the veins of the neck and face, but also of the abdomen where there were enormous varices. Here two electrolytic séances were had, and a favorable result was obtained, *i. e.*, there was a notable diminution in the pulsations of the tumor and in the intensity of the pain; unfortunately Dr. Ball was not able to follow the subsequent history of the patient who insisted on returning to his distant home. You will find the details of this case published by Rivet, *hospital interne*.

My old preceptor, Dr. Bernutz, has also sought my help in the treatment of an aneurism of the ascending portion of the aorta forming a tumor in the right side of the chest; but here, as in the case of my patient, there was aortic insufficiency. After three sittings we noticed less of pulsation and of pain, and a considerable amelioration in the general condition.

More recently still, at the Cochin hospital, Bucquoi has performed electrolysis on an aneurism of the ascending aorta which made a notable bulging from the thorax. The patient was a horrible sufferer, and could only obtain relief and rest by taking opium and bromide. After electrolysis there was so great improvement that the very day of the operation the patient could sleep without medicine, and at the end of a fortnight a marked diminution was noticed in the pulsations and in the size of the tumor. Operated on for the first time June 12th, 1878, this patient was pre-

sented to the Academy, Jan. 29th, 1879, in such a state of amelioration, that we were justified in regarding him as at least temporarily cured. He, however, succumbed some time afterwards to the progress of the disease, but not till he had for several months enjoyed the benefits obtained from electrolysis. Lastly, I was the first physician who had the hardihood to introduce the needles into the innominata for aneurisms of this region, and I will shortly give you the details of two cases of this kind.

The following more full account of Bucquoi's patient will be read with interest in this connection. It is the report originally presented by Bucquoi to the Academy:

E. D. G., aged 55 years, married, by occupation a washer-woman. Entered Cochin Hospital May 29th, 1876. Patient had enjoyed previous good health, notwithstanding the hard and laborious life she had led, the loss of several children, the abusive treatment of her husband, and the care and worry she had undergone. Eighteen months before her admission to the hospital, she began to feel tearing pains, first in the right arm, then in the thorax in the right mammary region; these soon took on the character of intermittent paroxysms.

The signs of an aneurism of the first part of the ascending aorta were present. Besides the keen pain felt on pressure over the second intercostal space, we already detected dullness at that point, six centimetres in its transverse extent, and a double aortic pulsation. The first sound of the aorta was dull, the second very sharp, but there was no murmur.

Rest in bed, the application of a blister over the painful spot, and the use of iodide of potassium internally, arrested the painful crises, and soon the patient was able to resume her occupation, which she continued a whole year without inter-

ruption. About the middle of May of the year following, and coincidentally with the supervention of a distress in the thorax and a dyspœna, which became constant, there appeared on the surface of the chest a painful tumor, which, in less than three weeks, attained the size of half of a large orange.

The patient again entered Cochin Hospital January 3d, 1878. She had lost flesh, presented a cachectic appearance, and complained of a continual distress, to which she attributed the loss of appetite and of sleep; her strength had much declined.

A voluminous tumor occupied the second, third and fourth intercostal spaces of the right side, causing a bulging at the surface of the chest, and presenting to the naked eye the impulse and the pulsation of aneurismal tumors. It was quite oval in form, 11 to 12 centimetres in width and 8 centimetres in height. Throughout its entire extent it had worn away the ribs and costal cartilages.

Auscultation gave a double murmur, but below the tumor the aortic sounds were normal, which warranted us in concluding that there was not aortic insufficiency, and this was also in accordance with the tracings obtained by Dr. Franck with the cardiograph of Marey. The heart seemed otherwise sound, as was also the case with the other organs; there was no difference in the two pulses, and there was absence of all symptoms of compression.

The symptoms from which the patient complained most were the severe pains felt in the aneurismal tumor and in the arm of the same side; to these pains was added an indescribable distress which rendered her situation intolerable.

In presence of a case so grave, whose rapid march made us apprehend a speedily fatal termination, could we hope to arrest the progress of the disease? Despairing of the ordinary methods of treatment, I decided to resort to the electrolytic method of Ciniselli. The large size of the tumor was, it is true, an unfavorable condition, but, in favor of the operation was

the general character and disposition of the sac, which seem to be quite circumscribed, and, especially, the soundness of the aortic orifice—a rare event in aneurisms of the first portion of the aorta.

On June 12th, with the assistance of my friend Dr. Dujardin-Beaumetz, I practised electrolysis in the aneurismal tumor, rigorously following the operative procedure as modified by him, and applied to the divers cases treated since then by several of my colleagues.

Two needles were plunged into the most prominent parts of the tumor, and were entered to the depth of $2\frac{1}{2}$ centimetres. The positive pole was put in contact with each of the two needles during five minutes successively; then the same process was repeated a second time for five minutes, so that the whole time during which the current was passed into the sac was twenty minutes.

There was severe pain throughout the operation, but it was courageously borne. This pain continued till evening, then disappeared almost completely, so that the patient slept quietly a part of the night, which she had not done before since her entrance into the hospital.

The next day, marked relief; pulsations in the tumor notably diminished; the tumor remained still painful, and there was a considerable degree of tension therein. For four or five days the pain and tension in the tumor persisted, and there was a slight febrile state; but all these local and general phenomena fast disappeared, and the improvement in the condition of the patient was most satisfactory. A fortnight after, electrolysis was performed the second time. Already the tumor had undergone a sensible diminution in its inferior segment, and the beatings were much less energetic. The sequelæ of the operation were the same as before: pain and pressure in the region of the tumor, slight febrile reaction, but shortly afterwards a feeling of inexpressible relief, return of appetite

and of strength, and reduction in the size of the aneurismal sac, in which no murmur was heard except with the first sound of the heart.

Three other electrolytic séances were had, the 16th and 30th of July, and the 13th of August. At the latter sitting, I added a third needle, which prolonged the duration of the séance to 30 minutes. Every time the same phenomena were observed; an inflammatory period at first, of short duration, little affecting the general condition; then recession of the sac, and induration more and more marked of a part of its extent.

The patient insisted on leaving the hospital to resume her occupation, and at the time of her discharge, August 23rd, the aneurismal tumor was reduced to less than half its former size, and appeared to have completely shrunk away in the region of the first punctures whose cicatrices remained; only a well marked bulging, which was the seat of visible pulsations, existed in the upper portion, and proved that the cure was not complete.

Two months afterward Madam G. returned to Cochin, suffering from fatigue and breathlessness; the aneurismal tumor had increased in size, and the pulsations were stronger. The lower portion of the tumor, however, remained sunken, and presented a notable hardness.

October 31st we subjected the patient anew to electrolysis, three needles being again plunged deeply into the tumor. From the first day of the operation, and while the consecutive inflammation in the sac still continued, all the general symptoms, pain, headache, dyspnoea, disappeared as by magic, and the patient began to feel as well as when she quit the hospital.

To keep up the gain which we had attained, to augment the volume and the consistence of the clots already formed in the aneurismal sac, we continued the electrolysis, which was practised Nov. 16th, Dec. 11th and Jan. 4th, (nine séances in all of electrization).

The general condition of the patient is quite satisfactory, she has a good appetite, sleeps well, and feels able to go to work. At rare intervals only does she complain of pain and palpitations. Never since the beginning of the treatment has she experienced those terrible attacks of pain which simulated angina pectoris, and menaced her existence.

As for the aneurismal tumor, great changes have taken place. In the greater part of the space formerly occupied by the sac, where the ribs and cartilages have disappeared, palpation discloses an indurated surface of almost cartilaginous consistence. This surface corresponds to the inferior half of the primitive tumor; there we find traces of the first punctures which were made over the most salient portion of the aneurism.

In this part a permanent coagulation is then obtained; the result is most satisfactory. Unfortunately there remains still, in the middle of the second intercostal space, a projecting portion about as large as a good sized almond, which preserves all the characters of the original aneurism: the impulse, the beatings, and the bruit with the first sound. Despite my perseverance, I have not been able thus far to obtain a coagulation extending to this remaining part of the aneurism. It is probable that this part of the sac is directly in relation with the aorta by the orifice of communication, and that it therefore feels more immediately the impulse of each ventricular systole.

However this may be, and notwithstanding the difficulty which we have found in provoking coagulation in this point, it must be at the same time remarked that since the last séances of electrolysis, this part of the tumor seems more resistant, which enables us to hope for results still more encouraging, perhaps for complete cure.

If we shall be as successful as we hope, this will be the first case of complete cure in the annals of medical science.

But whatever may be the future in store for our patient, the details of this case plead powerfully in favor of the electrolytic treatment of aneurisms of the aorta. You have seen how rapid was the progress of the disease, and how threatening the danger. From the first application of electrolysis, the march of the disease was interrupted, and a condition of comfort and health has succeeded the pain and distress from which the patient had heretofore suffered continually.

But the most remarkable case which I have ever observed is that of a patient who was sent to me by Dr. Boisson, of Lure. For a whole year this patient never quit his bed, and only lived by the help of injections of morphine, and when he arrived in Paris he was taken with frightful attacks of hæmoptysis; and so unpromising was his condition when I first saw him that I did not dare to operate, for fear that he would die in the operation. Nevertheless, on the earnest entreaty of the patient, I decided to make the venture, and this, as much for its moral effect on the patient, as for any curative effect. The first electro-puncture, however, gave an excellent result, and after five séances the patient returned to his country so much benefited that he was able to resume his business as contractor. Six months afterward I repeated the operation, and there was again an improvement which lasted several months, then the patient returned to Paris to submit to still a third operation, but he died suddenly before the necessary arrangements could be made. This man experienced for two years the benefits of electrolysis.

It now remains for me to point out to you the improvements which have been made in the mechanical details of the operation. I explained all these improvements to the Congress for Advancement of the Sciences, at the session held in Paris in 1878. I have since modified the voltameter and Gaiffe has constructed an instrument which I here place before you, the management of which is simple, and renders it much superior to the one which we before used. (Fig. 5.)

Since then, owing to the introduction of methodi-

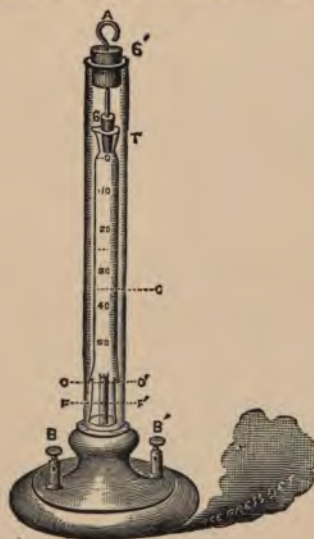


FIG. 5.

Explanation of the Figure.—P, the foot stand. B B', stops to which are attached the rheophores, and which communicate with the platinum wires, F F'. C, graduated glass tube, in which are produced and collected the gases of decomposition. T, the outer glass tube which serves as a reservoir for the liquid. O O', openings by which the liquid is admitted into the outer tube. b, stopper which closes the tube C, and is withdrawn by means of the wire A with ring, b', cork through which passes the wire A, and which closes the tube T. To work this apparatus, you remove the cork b', fill the voltameter with water acidulated with 1 per cent. of sulphuric acid (the liquid ought to rise a little higher than the inner tube C), then you reinsert the cork b' and push down the inner cork b till its lower margin just touches zero of the scale.

After the operation you remove the inner cork b to let the gases escape and the inner tube fill itself again with liquid, then you replace b and the apparatus is ready for use again.

cal measures in galvanometry, instead of using these voltameters, you may employ to good advantage, the galvanometer of Gaiffe which is divided into milliamperes, and you will give to the current, in the electrolysis of aneurisms, an intensity which corresponds to twenty-four milliamperes.



The introduction of the needle is painful. As you are obliged to employ a needle with some stiffness, on account of the possible danger of breaking, you will understand the difficulty, in view of their fineness, of making these needles penetrate far into the tumor. Hence Gaiffe has constructed, according to my directions, an instrument which enables you easily to enter the needles into the substance of the tissues.

FIG. 6.

I here show you the instrument, whose

mode of working you can understand at a glance. (Fig. 6.)

This apparatus is composed of a metallic tube T, in the end of which is introduced the needle A; of a steel piston rod P, with which may be exercised the necessary pressure on the head of the needle. The diameter of the lumen of the tube is just large enough so that the needle may be easily inserted, and not bend under the pressure: A second tube, which slides on the first, and is firmly connected with the piston rod, gives rigidity to the instrument and carries an index (G) which enables you to follow the movement of the needle and gives you the depth to which it penetrates.

The extraction of the needle presents some difficulty, and is also painful. The needles are oxidized and become so rough as to hinder removal. Another instrument (Fig. 7), also invented by Gaiffe, renders the extraction more easy. You see that it looks very much like one of those English cork-screws which play in a cylinder, the inferior extremity of which rests on the neck of the bottle, and thus finds a fulcrum which enables the screw to grasp the cork and extract it by a few turns of the nut.



FIG. 7.

As for the dimensions of the needles, I think it preferable in the first séances of electro-puncture to employ needles having a very small diameter—a minimum of five-tenths of a millimetre, for if below this figure, the chemical action of this current may cause

the needle to break, which would be a serious accident. In proportion as coagulation is effected you can make use of larger needles, which should be passed through the entire thickness of the clot into the liquid portion of the sack.

As for the negative pole, you remember that in the operation described, I placed it on the side, and at the lower portion of the chest. The movements of respiration, however, interfere with exact juxtaposition; therefore I have latterly been in the habit of placing this pole on the hip in order to overcome the intermittence of the current which I had noticed in the first operation. Moreover, to avoid the smarting sensation caused by the negative electrode, which produces a rubefaction which is often very intense on the points of the skin where it is applied, I have had the metallic plate perforated with a series of holes, by which the chamois skin which covers the plate and separates it from the cutaneous surface, may easily be kept moistened. But I think that we may readily dispense with this negative plate by employing the ingenious process recommended by Apostoli, and which consists in terminating the negative pole in a mass of moist clay, which is applied to the skin; this clay may be placed on the thorax in proximity to the aneurism. I have not yet tried this modification in the electrolysis of aneurisms, but have used it in that of hydatid cysts of the liver, and with decided advantage.

As for the proper pole to be used in connection

with the entering needles there has been much dispute of late years. You know my preference for the positive pole, and the reasons which I have given why no other current but the positive should be passed into the interior of the tumor. The negative pole gives rise to the evolution of gases, and the clot which it determines presents no consistency; moreover the application of the negative pole is painful and may occasion hemorrhages.*

Lately Bacchi has affirmed, as the result of numerous experiments on animals, that the dangers apprehended from the introduction of the negative pole were illusory; he has particularly insisted on this point that the quantity of gas set free in the sac can have no injurious effect.

But one of my pupils, Dr. L. Robin, who has published quite a complete thesis on the treatment of aneurisms by electrolysis, has repeated these experiments and has arrived at results quite contradictory to those of Bacchi.

These are the conclusions of Robin's thesis, which sums up a series of researches undertaken in the physiological laboratory of Sarbonne :

1. The coagulation of albuminoid matters is effected at the positive pole:

*This has been well shown by some experiments of Tessier, in which he introduced the negative needle into the arteries of dogs. Ulceration with perforation of the artery was found at the point of penetration of the needles. (L. J. Tessier; *On the therapeutic value of constant currents*, Paris, 1887.

2. The reasons which should cause the exclusion of the negative pole in the electrolytic operation of aneurisms, are as follows :

(a) The lessened firmness of the clot; the imprisonment of molecules of hydrogen in the coagulum formed, leading consecutively to its partial disaggregation and disintegration.

(b) The distention (sometimes considerable) of the sac by hydrogen gas.

(c) The profuse hemorrhages which are to be dreaded; the inflammation and formation of little abscesses at the point of introduction of the needles; the suppuration and sphacelus of the arterial walls; the production of diffuse aneurisms in the neighboring tissues. (*Robin, On the treatment of aneurisms by electrolysis. Paris, 1879.*)

In Scotland, in a recent discussion before the Medical Society of Glasgow, we noticed the same uncertainty existing as to which of the currents to use, and while Anderson employs only the positive current, Duncan uses both positive and negative currents. The latter maintains that when you wish rapidly to fill the sac with clots, it is absolutely necessary to employ both currents.

The following is the substance of the important communications of Anderson and Duncan to the Pathological Society of Glasgow, May 11th, 1879:

Anderson reported two cases of thoracic aneurism. The first patient was relieved by electrolysis, left the hospital and resumed her occupation; she eventually died from rupture of the aneurism into the pleura. The post-mortem showed consolidation to be complete.

The second case, admitted to Glasgow Hospital April

16th, 1877, was one of voluminous aneurism of the aorta, of eight months' standing, in a man æt. 52. This case in many respects resembles the first case reported in this chapter (Dr. Dujardin-Beaumetz' patient). Treatment by gramme doses of KI. had failed, as also by large doses of tincture of veratrum viride. Afterwards tincture of digitalis was prescribed in 14-drop doses every 4 hours. The 12th of August a diminution of visual acuteness in the right eye was noticed; the pupil was dilated and sluggish; there was a sense of constriction at the base of the tongue. Sept. 20th there were pains in the arms, and the pulsations in the tumor were more marked and very painful. Oct. 15th the tumor was prominent and soft, almost fluctuating, and the walls of the sac were very thin.

Dec. 3d, Dr. Anderson performed galvano-puncture. Before the operation the tumor was four inches in diameter, and projected an inch and a quarter above the surrounding parts. The beatings were very pronounced. The apex beat was $3\frac{1}{2}$ inches to the left of the nipple; the radial pulse was feeble, and the air entered the left lung more freely than the right.

The operation lasted an hour. The needle (positive pole) was introduced into the third left intercostal space; four elements were employed during the first half hour, and six during the second. In removing the needle, some dark blood spurted from the point of puncture; compression was made with the finger, but the blood continued to flow. The hemorrhage was arrested by ice and compression with finger, afterwards with a sand-bag kept applied a whole day. Dec. 7th, the tumefaction caused by the infiltration of blood had mostly disappeared, and the pain had markedly abated. The amelioration continued, and the patient left the hospital Feb. 7th, 1878. The tumor was now much swollen and hard, and the pulsations were much less energetic; the pain had disappeared. Since leaving the hospital he had enjoyed comfortable health; was able to walk eight or ten miles a day. March 5th, 1879, he visited the

hospital. There was then a little pulsation in the tumor, and a slight systolic murmur, but scarcely any pain. On the whole, the operation was very satisfactory.

Anderson employed the constant current from Stohrer's battery, adding to the contents of each cell, four grammes of a solution of chromic acid, according to Althaus' recommendation, to augment the chemical effects. The needles were insulated down to half an inch from their points by a coating of vulcanite. He used only the positive pole, for reasons before given. He employed 4 to 8 elements, never prolonging the operation more than an hour. He thinks electrolysis applicable only to a limited number of cases, and when the aneurism is situated high up, or affects one of the large vessels, Anderson thinks that ligature may be preferable.

Duncan, of Edinburgh, affirms that the only treatment of internal aneurism is electrolysis. He has employed this method in three kinds of cases: The first class comprises those where death from hemorrhage was imminent, where the skin was thinned, and beginning to sphacelate; he reports five cases. In the first, there was an enormous extra-thoracic tumor which bled profusely an hour before the operation. There was arrest of the hemorrhage, but the patient died from exhaustion ten days afterward. In the second case, there was considerable production of gas, and a slight hemorrhage from the sphacelated part during the operation. The result was almost complete disappearance of the tumor. The patient survived five months, and died of erysipelas and empyema. In the third case, death came on the second night after the operation from external hemorrhage from the gangrenous spot. In the fourth, there were two sésances, which produced complete cessation of the pulsations, and a great diminution in the size of the tumor. Death took place five weeks after, from rupture into the pericardium. In the fifth case there was but one electrolytic sitting. The sphacelated portion of the skin separated,

the orifice was found closed by a solid clot, but an abscess formed at this point in the walls of the aneurism, and death supervened by hemorrhage 21 days afterward. A very large clot was found in the tumor.

Duncan's second class comprises the cases in which there was an extra-thoracic tumor of considerable size, progressing, in spite of treatment by the method of Tufnell and iodide of potassium, and in which, consequently, death was threatened from external hemorrhage. Duncan has treated six cases of this kind by electrolysis.

"In the first case, the tumor was very voluminous. After the first séance, hardening and reduction of the tumor; result stationary at end of a fortnight; new improvement after the second séance, but five days afterward, rupture into the pleura and death."

"In the second case, there was an external tumor size of an orange, growing rapidly; three sittings; slight and temporary amelioration after each, but death from intra-thoracic rupture."

"Third case: three séances; marked amelioration after each; the patient was lost sight of for several months; the tumor increased in size; death took place from external hemorrhage."

"The fourth case was one of voluminous tumor; considerable and progressive diminution for five weeks with relief from pain; the patient returned home, and we heard no more of him."

"In the fifth case, tumor size of half an orange, increasing slowly. After the first sitting, diminution in size, which continued under the use of iodide of potassium. After six months of treatment, the patient's son informed Dr. Duncan that there was no longer any tumor and that his father was well."

"In the sixth case two séances. At the end of seven

weeks, the tumor had nearly shrunk back to a level with the chest wall. Eight months after, sudden death, but not from external hemorrhage."

The third class comprises cases in which there existed an intra-thoracic tumor which had resisted the action of other means. Duncan has operated in two cases of this kind.

"In the first, a tumor was felt in the jugular fossa; the *manubrium sterni* was in part resorbed; considerable dyspnoea; immediate and continued improvement after the operation; the patient, a washerwoman and a drunkard, resumed her occupation and her vice, and death took place several months after. In the second case, there was a slight bulging in the second right intercostal space; marked amelioration after the operation, but the patient left the hospital before the second séance."

"The choice of the pole to employ depends on the end proposed. For instance, when you wish to prevent an external hemorrhage, your object is to fill the sac as completely as possible, and you should introduce both positive and negative needles. If there is no urgency you may be content with one. In intra-thoracic tumors, it is better to employ the positive pole, not to produce a great amount of electrolytic action, but to cause the formation of a small clot, around which the fibrine may deposit itself in successive laminae. The clot formed at the negative pole is so extremely soft that it poorly fulfils this end. The duration of the séances depends also on their immediate object. If you wish to fill the sac, your séance should occupy one, two, and two and a half hours. If you wish to form a small clot as a nucleus, from twenty to twenty-five minutes will suffice. The kind of apparatus does not seem to be of great importance, but it is essential, whatever be the battery employed, to try the effect of the current in coagulating the white of egg before the operation."—(British Medical Journal, April 5th, 1879.)

As for myself, I shall maintain, till better enlightened, the views already expressed; and the trials which I have made, or have seen made, with the introduction of the negative current into the tumor, have not encouraged me to adopt the practice of Ciniselli, and I would advise you to use only the positive current in the treatment of aneurisms.

Lastly, do not forget that if the first application of electrolysis is attended with a notable amelioration, if the pulsations diminish in intensity, if the throbbing pains and the aching in the vicinity abate, if the tumor decreases in size, this is not enough; and in order to procure a complete and lasting coagulation in the sac, you should have recourse to renewed applications of electricity. It is necessary that these séances should not be too near together; it has, in fact, been generally remarked that the improvement is not always immediate; it often happens that the next day after the operation the tumor seems to take on an increased development, then the following days the swelling abates, the tumor decreases in size, and the amelioration goes on progressing.

This is in accordance with the results of experiments, which show that in animals on which electrolysis is practised in the arteries, obliteration is not produced immediately after the passage of the electric current, but the second or third day after the operation. It is easy to see, moreover, that when once some degree of coagulation is obtained, the clot serves

as a nucleus for new depositions of fibrine which increase its thickness. It is necessary, then, to wait till the condition of the aneurism becomes stationary before resorting to a new electro-puncture operation, and this generally requires a delay of three or four weeks.

You will thus be able at sufficiently wide intervals to have five or six séances of electrolysis, and even more, if this should be necessary. There is still another reason which should cause you to make the séances of electro-puncture wide apart, namely, the inflammation of the sac determined by the passage of the current. If you operate when the sac is painful and inflamed, the pain is so intense that the patient cannot bear the operation. Wait, then, before making a new electro-puncture, till the tumor is little or not at all painful to pressure.

After each operation I was in the habit of applying ice to the tumor; this practice I have since abandoned, as more likely to do harm than good, and I reserve the use of refrigerants for cases where, in consequence of the inflammation determined by the passage of the current being too great, it is necessary to mitigate its effects.

I have never had any accident during my operations of electrolysis. It is very seldom that any hemorrhage takes place from the punctures, and when any oozing does take place, it is so slight that a little pressure with the finger and the application of collodion will generally promptly arrest the flow.

The pain caused by the passage of the current into the tumor is sometimes very intense; plucky patients, however, bear it very well. This pain generally consists in a feeling of tension in the interior of the sac; in other cases it is like that characterizing certain attacks of cardiac angina, that is to say, the patient experiences a painful sensation of constriction and of weight in the tumor, and it is probable that this distress results from the electrization of some branch of the cardiac or pulmonary plexus. In one case, even, which I saw along with Drs. Peter and Delpeuch, the passage of the current caused a grave attack of syncope which compelled us to give up the operation.

There remains a last question which I can but touch upon here, namely, the action of electricity in the cure of aneurisms. Does the current by its presence directly determine coagulation, or does it simply originate an inflammation which gives rise to this coagulation? I am persuaded that it is chiefly in causing inflammation of the sac that electricity brings about the cure of aneurisms of the aorta. In support of this opinion I must call your attention, first of all, to the report of autopsies, which always show clots adherent to the point where the needles have penetrated; then to the way in which symptoms of amelioration manifest themselves, that is to say, gradually, and several days after the passage of the current; and I am certain that my last operations,

which have had to do with aneurisms of the arteria innominata, plead in favor of this view.

If electricity acted by immediately causing coagulation around the needles, embolisms would not fail to be produced, and never in the two cases of brachio-cephalic aneurism referred to did any accident of this sort happen. One of these facts had to do with an aneurism of the aorta and of the brachio-cephalic trunk, in one of our confreres; there was considerable interference with respiration on account of pressure on the trachea and recurrent nerves. Electro-puncture, repeated several times, resulted in hardening of the aneurismal tumor, and marked relief from the distress, but could not prevent rupture of the sac into the trachea, which took place three months after the first séance of electrolysis.

The second case was that of a woman whom my old teacher, Moutard Martin, sent to me for examination, and who is now a patient in the Hotel Dieu. This woman, who has an aneurism of the innominata, is still under treatment, and the first séances of electro-puncture have caused the cough to disappear, and reduced the size of the tumor, without producing any embolic or other accident.

Therefore, in generalizing from these facts, I have come to the conclusion that the cure of an aneurism of the aorta cannot be brought about without inflammation of the sac, and that ice, like electro-

puncture, does good only on condition of determining a curative endarteritis.*

Such, gentlemen, are the considerations which I desired to present relative to electrolysis, as applied to the treatment of aneurisms. I hope that I have shown you that this operation, which seems hazardous and difficult of execution, is really one of the most simple and easy, and that when once the diagnosis is settled, you may, without danger (and I insist on the words, *without danger*), resort to the application of this means. I believe that the multiplicity of cases in which recourse has been had to electrolysis, and with signal success, will cause this operation to become a favorite one, and that this mode of treatment of aneurisms of the aorta will eventually be regarded as the most promising.

But what results are you to expect from this operation? Complete cure? This must always be of exceptional occurrence; but even if we could obtain complete coagulation of the contents of the sac, we should have a solid tumor remaining which would im-

*Constantin Paul, persuaded, like Dujardin Beaumetz, that electricity cures aneurism only by virtue of determining an inflammation more or less intense, has proposed to bring about this inflammation by simple acupuncture of the sac; he has performed this acupuncture according to the Japanese method; and in a patient aged 40 years, suffering from aneurism of the aorta, he has obtained considerable amelioration, characterized by a diminution of the pulsations and of the pain. (Soc. de Ther., Mar. 12, 1879.)

pede the circulation. Complete coagulation is, however, very difficult to obtain. If we could penetrate on all sides the aneurismal pouch, we might determine the production of a protective envelope of clots, which would save the patient from the danger of rupture. Unfortunately, we are not able to do this, as we are obliged to enter the sac in points where it comes in contact with the skin, and to leave uninfluenced by the action of electricity points most exposed to the danger of rupture.

Despite these unfavorable conditions, improvement has always followed the application of electrolysis; the pains have diminished, the pulsations have been less marked and less troublesome; and if we take into consideration, on the one hand, the harmlessness of the operation, and, on the other, the relief which it is sure to bring, there ought to be no hesitation in resorting to electro-puncture, a complete and permanent cure being, however, regarded as something hardly to be expected. In the present state of therapeutics, moreover, it is the only operation on which we can depend for beneficial results, and such as these are, we must be satisfied with them.

APPENDIX.

I.

ANTIPYRINE IN ANGINA PECTORIS.

Professor Germain Sée has recently derived benefit from antipyrine in angina pectoris, the pain speedily yielding under the influence of gramme doses frequently repeated till four or five grammes are administered. The doses may be given one hour apart. On account of its solubility in cold water, this is a convenient vehicle for the administration of antipyrine. The new remedy is perfectly safe, the only unpleasant effect following its administration being occasionally a little nausea or vertigo. It is only recently that Professor Sée has made trials of antipyrine in subcutaneous injections. He finds this method eminently safe and efficacious. One half gramme ($7\frac{1}{2}$ grains) is dissolved in a hypodermic syringe of distilled water and injected, as morphine would be injected, for pain. The injection first produces a painful sensation of tension, which lasts but a few moments. Then a marked abatement of this pain ensues.

Professor Sée calls attention to the fact that antipyrine in subcutaneous injection is attended with none of the unpleasant after effects, which are almost constantly produced by morphine.

II.

THE USE OF STROPHANTHUS IN DILATATION OF THE HEART.

S. C. Chew, M. D., Professor of the Principles and Practice of Medicine in the University of Maryland, read a paper recently before the Clinical Society of Baltimore, of which the following is an extract.

It is probable that many members of this Society are familiar with the admirable article of Professor Thomas R. Fraser, of Edinburgh, on the action and uses of strophanthus in cardiac affections, which was published in *The British Medical Journal*, in November, 1885. The article is deserving of the highest commendation for the careful way in which the observations reported were made, and the clear reasoning from those observations which it shows.

As some present may not have seen the paper, I may be permitted to refer briefly to its leading points before speaking of the use which, under its guidance, I have myself made of strophanthus in the case which I purpose to report here, and which was one of the first in which the drug was employed in America.

The strophanthus is an African plant, found both on the western coast of the continent of Africa, in Senegambia and Guinea, and on the eastern coast along the Zambesi River. It is endowed with very active properties, for which it is used by the native tribes as an arrow poison both in hunting and in war. The poison is said to be prepared from the seeds of the plant, which are formed into a paste for this purpose. These seeds contain a crystalline principle, soluble in water and in rectified spirit, with a strongly bitter taste, and not alkaloidal in character. This is found also in the leaves and bark of the plant, but

in less amount than in the seeds. This principle Professor Fraser terms strophanthin. In its action upon the frog's heart strophanthus is synergistic with digitalis, increasing the strength of its contractions, more especially the contraction of the ventricle; and, when a sufficient amount is applied, producing a strong or even tetanic contraction of the ventricle, so that the heart ceases to act in extreme systole. It is asserted by Dr. Fraser that the strophanthus in like manner increases the contractile power of all striped muscles, rendering their contractions more complete and prolonged; but that the heart is more distinctly and powerfully affected than other muscles, because it receives a larger quantity of blood than others do. But while the strophanthus is like digitalis in this action, it is very much more powerful than that drug. Some experiments of Dr. Fraser on this point show that a solution of strophanthin of one part in 10,000,000 produces a ventricular contraction of a frog's heart greater in energy than that caused by a solution of digitalin of one part in 4,000; for the digitalin solution while producing the usual changes in the heart's action, *i. e.*, increasing its contractile force and slowing it, does not arrest it; but strophanthin solution stops it in extreme systole. The difference in the power of the two agents, as thus shown, is very striking. But another difference between them, and one that may be equally important from a therapeutic point of view, is this: that whereas digitalis by an action on the blood-vessels themselves, distinct from its influence on the heart, causes increased tension and resistance in these vessels, strophanthus, on the other hand, does not act in this way, except to a very slight degree, if at all. Here again the contrast in the action of the two drugs was well shown by experiment. A solution of one part of digitalin in 20,000 when passed through the blood-vessels produced in a few minutes such extreme contraction of them as to prevent the solution from passing any longer. A much stronger solution of strophanthin, one part in

3,000, on the other hand, caused no noticeable change in the vessels, while only a slight and temporary action was produced by a solution of one part in 2,000.

This difference would again seem to make in favor of strophanthus as a therapeutic agent. For it would seem likely that in embarrassment and retardation of the circulation the beneficial effect gotten from the increased power which digitalis gives the heart is, to a certain extent, antagonized and lessened by the resistance which it causes in the blood-vessels. But, on the other hand, by the use of strophanthus not only we have increase in heart-power, but all of the power thus gained, unhampered by obstruction in the arterioles, is directed against venous stasis.

These two circumstances therefore—first, more powerful action as a heart energizer, and second, non-action upon the blood-vessels—would make it probable that strophanthus is a more efficient therapeutic agent than digitalis in the treatment of cardiac dilatation and the symptoms resulting from it.

And so in the cases reported by Professor Fraser it proved to be.

The one case in which I have made use of the drug is, so far as I have yet been able to ascertain by inquiring among my professional friends, the only one in which it has been employed in this city, with the single exception of one case of later date than mine, in which Dr. I. E. Atkinson has used it, and in which either from the advanced state of disease or unsatisfactory quality of the drug, no appreciable result was obtained from it.¹

The preparation of the drug which I have used is a tincture which was given to me by Dr. William T. Howard, to

¹ Dr. Atkinson has informed me since the reading of this paper that he has recently used the drug with strikingly good effect.

whom it was presented last summer, while he was in London, by Dr. Fraser, as a specimen made by himself. I should have used it in a number of other cases with hope of good results, but my supply of this tincture was small, and I preferred to test its value on one case as fully as was possible with the small amount at my command. In this case it has appeared to substantiate fully the claims made in its behalf by Professor Fraser.

CASE.—Ella —, aged about twenty years, came under my charge in the Hospital of the University of Maryland, in October 1886, when I found her suffering with general cardiac dropsy. The feet and legs were considerably swollen, but the largest amount of fluid was in the abdominal cavity, which was very much distended, so that respiration was greatly embarrassed and the patient prevented from lying down. For this she had been treated with digitalis, without much benefit, and she had been twice tapped. On examination the area of cardiac dulness was much increased, the heart's impulse diffused and lessened in intensity, and a loud systolic murmur at the apex and in the scapular region showed extensive mitral insufficiency with consequent dilatation. The pulse ranged at from 112 to 120 per minute, and the amount of urine was from fourteen to sixteen ounces in the twenty-four hours. It contained no albumen. The condition of the patient indicated the use of digitalis or other agents synergistic with it; but it was evident that with the great pressure upon the abdominal viscera and upward against the diaphragm there could be no fair and satisfactory test of drugs directed therapeutically to the heart and kidneys. I accordingly tapped the girl on October 26th, drawing off more than a gallon of fluid, with the effect of relieving her extreme dyspnoea and allowing her to lie down. Two days afterward I put her upon the use of Dr. Fraser's tincture of strophanthus in the doses, at first of two drops, and after three days, of four drops, three times a day.

Now, it is clear that in endeavoring to estimate the value of any agent given under such circumstances, there is an obvious fallacy to be guarded against. An effect really due to the tapping might be erroneously ascribed to the action of the drug; for such results as ability to take the recumbent position, and an increase in the amount of urine, could be brought about by the direct withdrawal of the fluid even more readily in many cases than by the use of medicinal agents. Against this fallacy I endeavored to guard carefully. In the first place I ascertained that after the previousappings, while the patient could lie down more comfortably than before, and the amount of urine was somewhat increased, yet this increase was but slight, and there was no noticeable change in the pulse either as regards diminution of its frequency or increase of its force. Prepared with this knowledge, on the second day after the tapping, October 28th, I began the use of Dr. Fraser's tincture of strophanthus in doses of two drops three times a day. In two days there was a conspicuous improvement in the patient's condition, and on the third day the dose was increased to four drops. The breathing was much easier; the recumbent position could be maintained longer; the pulse, which had pretty constantly ranged at from 112 to 120, and had not improved after the previous tapping, was reduced to 84 per minute, and increased at the same time in fulness and strength; the impulse of the heart was more forcible, and the urine was augmented in quantity from one pint or less, daily, to more than three pints. This improvement continued steadily for ten days, the patient being out of bed and walking about the ward, and expressing herself as feeling far better in every way; when, in order to guard more perfectly against the source of fallacy referred to, I withheld the drug. In two days the patient's breathing became more oppressed, the heart's impulse lessened in force, and the pulse arose above one hundred. She begged me to give her again the medicine

from which she had experienced so much relief. Its use was followed as before by prompt mitigation of the symptoms; and with occasional omissions that were followed by a return of these symptoms, which were again relieved by a recurrence to the medicine, she took it until my supply of Dr. Fraser's tincture was exhausted when, being left without the medicine, she had a return of the urgent distress. I then obtained a specimen of tincture of strophanthus from a New York importing house; but although some relief was gotten from this, yet, either from an inferior quality of the drug, or because of the more advanced and irremediable condition of the disease, the response to the medicine has become less and less, and finally has ceased to be afforded at all. The dropsy has increased in amount, the quantity of urine diminished, the heart's action has grown feebler, and the dyspnœa has become more urgent and distressing.

About one week after the reading of this paper the patient died. The post-mortem examination confirmed the diagnosis of mitral incompetency and dilatation of the heart, both of which conditions were found in an extreme degree. The amount of morbid alteration in the mitral orifice and valve was very remarkable, the two leaves of the valve being destroyed to such a degree that only two small stubs were left, so that their function must have been completely lost. The circumference of the mitral orifice was converted into a hard and rough ridge of calcareous matter, and the ventricular wall was extremely attenuated. The death of the patient under such circumstances, so far from invalidating the efficacy of the medicine, showed its power the more clearly by revealing the great difficulty against which it had to contend, and which it for the time relieved.

Since my first use of strophanthus in this case I have employed it in others similar in character. I have also used it as a cardiac tonic in other cases of weak heart without valvular

or other discoverable organic disease. In one case of double pneumonia, now convalescent, in which there was great danger from extreme feebleness and intermittence of the heart, it has been manifestly beneficial. Indeed, it has seemed to me to produce some good effect always in such conditions in the way of increasing the contractile power of the heart. Such uses of the drug are suggested by Dr. Fraser. But in no case has its efficacy been more conspicuous than it was in the one above reported, in which, nevertheless, the amount of disease was necessarily fatal.

That any response to a medicine should have been made under such circumstances, or any improvement have occurred, was remarkable; and yet over and over again, in this advanced stage of disease, the most unmistakable benefit was wrought by the strophanthus.—*Medical Record*, May 9th, 1887.

Previous to the publication of the above paper, Dr. Vincent Y. Bowditch published in the Boston Medical and Surgical Journal (March 17th, 1887) a valuable paper on Strophanthus. He reports four cases. The first was one of mitral disease, where the heart was effectually toned up, and breathlessness relieved. The second case was also one of mitral lesion, with dilatation of the heart, intense dyspnoea, irregularity of heart's action, a tendency to asystolia. Strophanthus, at first given in three-drop doses, was pushed to fifteen and twenty drops t. i. d., with marked improvement. In this case digitalis, sparteine, and caffeine had failed. The third case was similar to the above; there was besides general oedema. Under strophanthus all the symptoms were ameliorated; the medicine had a marked diuretic action. The fourth case was one of fatty degeneration of the heart, with irregularity of pulse and attacks of faintness. The heart's action and the general condition have improved with the use of strophanthus in pretty large doses.

In the N. Y. Medical Record, Dec. 18th, 1886, are reports

of cases by Dr. C. L. Dana, the only ones previously made public in America. Dr. Dana's results, in a comparatively small number of cases, are such as to make him believe that strophanthus is a valuable addition to our materia medica, and may often be used to advantage as a substitute for digitalis.

Lastly, in the *Bulletin Général de Thérapeutique*, Aug. 31st and Sept. 15th, 1887, we notice, as we go to press, an exhaustive study by Dr. Lucien Deniau of strophanthus, which is now being experimented with in the Paris hospitals.

TRANSLATOR.

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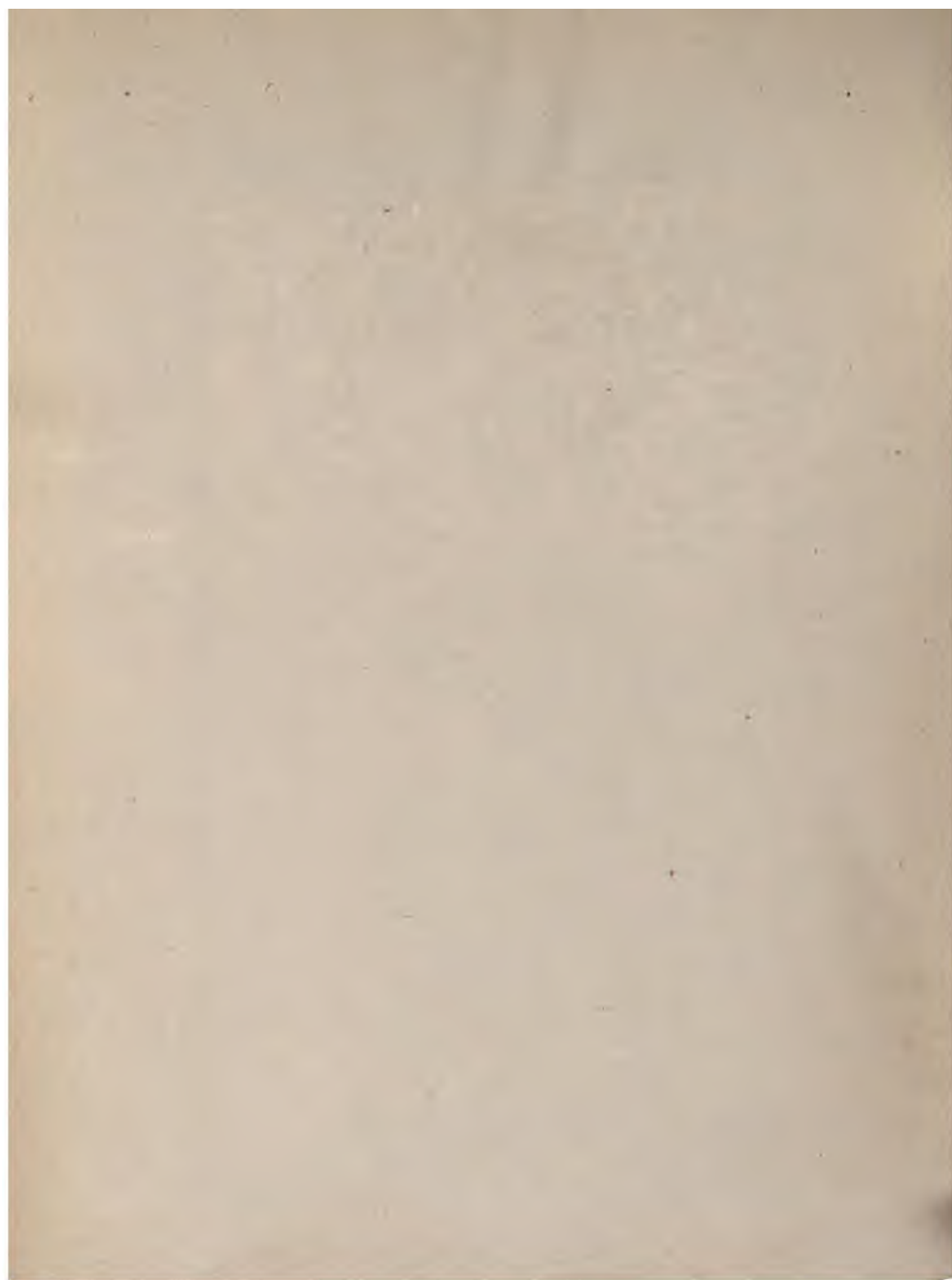
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